HOWARD'S CALIFORNIA CALCULATOR

AND

GOLDEN RULE

FOR

EQUATION OF PAYMENTS

TWO SHILLINGS.

C. Frusher Howard

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HOWARD'S

CALIFORNIA CALCULATOR,

AND

GOLDEN RULE

—FOR—

EQUATION OF PAYMENTS.

THE

Newest, Quickest and most Complete
Instructor for all who
desire to be

"QUICK AT FIGURES."

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PREFACE.

THE ability to make business calculations with ease, accuracy and rapidity, is an all-important acquisition to every class of the community. The whole system of numerical science has hitherto been so abstruse and difficult as to deter all, but a small per centage, from giving the weary months and years of time, labor and study necessary to master its mysteries. WONDERFUL and STARTLING discoveries have RECENTLY been made and embodied in the following rules, simplifying and shortening all the operations of numbers, so as to make RAPID CALCULATION easy to all;

The rules taught in Schools are needlessly weighted with superfluous elements, that only serve to encumber the operations, and distract, and confuse the learner; the Rules here taught avoid all this, and by an easily learned, simple, and natural arrangement lead directly to the required answer.

They are especially adapted to that large class of persons who find it difficult, or impossible, mentally to grasp, and retain complex numbers; such persons will find in this book

"A Complete Teacher of Business Arithmetic"

all the examples being worked out, and explained so as to be readily understood, transforming the drudgery of calculation, into a pleasing pastime, and qualifying persons of ordinary intellect, to surpass the performances of the "Lightning Calculators" who have astonished mankind.

PREFACE.

In actual business, the smart, practical men, *the men who make fortunes*, rarely use the methods of calculating taught in the schools; the value of time compels them to substitute *easy* and *rapid* rules for the *clumsy*, *cumbrous* and *tedious* processes found in the books.

The Rev. Dr. O. P. Fitzgerald, Ex-State Superintendent of Schools, California, says: "I have examined these new methods of calculation; they are remarkable for *originality*, and of great practical value, they are peculiarly clear and comprehensive in their adaptation to all possible cases.

"Since these simple and novel rules have been published, no Teacher, Student, or Man of Business can afford to be without them, any more than they can afford travel by *ox teams*, now the *railway* spans the continent."

The Author specially cautions all Book Pirates that his sole rights and title to the following Rules are legally secured and will be maintained against all infringements.

HOWARD's Golden Rule for Equation of Payments.

" " " " Averaging Accounts.

" " " " Partial Payments.

Computing Interest on a Basis of one per cent.

Computing Interest by inverting the Rate.

Squaring numbers by complement and supplement

California Calendar for thirty centuries,

TABLE OF CONTENTS.

CALIFORNIA CALCULATOR.

DEFINITIONS AND SIGNS.

ARITHMETIC is the science of numbers, and the art of computing by figures.

ABSTRACT NUMBER.—An abstract number is a number used without reference to any particular object, as 9, 745, 9764.

ADDITION, the act of adding, opposed to subtraction.

ALTITUDE, height.

ALIQUOT.—An *aliquot part* of a number is such a part as will exactly divide that number.

AREA, the surface included within any given lines.

ARITHMETICAL SIGNS are characters indicating operations to be performed, and are indispensable for briefly and clearly stating a problem:

+, *plus*, and more, signifying addition;

—, *minus*, less, signifying subtraction;

$\times$, *multiplied by*, as $2 \times 2 = 4$;

$\div$ or : *divided by*, as $6 \div 3 = 2$, or $6 : 3 = 2$, or $\frac{6}{3} = 2$;

$=$, *equality*, or *is equal to*, as $6 + 2 \times 2 = 16$, and is read thus, "6 plus 2, multiplied by 2, equals 16";

$2 : 4 :: 4 : 8$, signs of proportion, to be read "as 2 is to 4 so is 4 to 8";

$\sqrt{9}$, sign of the square root, read "the square root of 9";

4^2, sign of the square, read "the square of 4"

∞, indefinitely great, infinite, infinity;

%, *per cent.*

AN ANGLE is the corner formed by two lines where they meet.

BASE, the lower, or side upon which a figure stands; the foundation of a calculation.

CONCRETE NUMBER, used with reference to some particular object or quantity, as 640 acres, 500 dollars.

CIRCLE, a plane figure comprehended by a single curved line, called its *circumference*, every part of which is equidistant from its center.

CIRCUMFERENCE, the line that goes around a circle or sphere.

COMPLEMENT, the difference of a number and some particular number above it, thus: Having 7, what is the *complement* of 10? Ans. 3, the difference of 7 and 10.

CUBE, a solid body with six equal square sides. A product formed by multiplying any number twice by itself, as $4 \times 4 \times 4 = 64$, the *cube* of 4.

CUBE ROOT is the number or quantity which twice multiplied into itself produces the number of which it is the root, thus 4 is the *cube root* of 64.

CURRENCY, the current medium of trade authorized by government.

DIVISION determines how many times any one number is contained in another.

DISCOUNT, the sum deducted from an account, note, or bill of exchange, usually at some rate per cent.

DENOMINATOR, the number placed below the line in fractions, thus, in $\frac{7}{8}$ (seven-eights) 8 is the *denominator.*

DECIMAL, a tenth; a fraction having some power of 10 for its denominator.

DECIMAL CURRENCY is a currency whose denominations increase or decrease in a ten-fold ratio.

DIVIDEND, the number to be *divided.*

DIVISOR, the number by which the *dividend* is to be *divided.* A *common divisor*, is a number that will *divide* two or more numbers without a remainder.

DIAMETER, a right line passing through any object.

DUODECIMALS are the divisions and subdivisions

of a unit, resulting from continually dividing by 12, as 1, $\frac{1}{12}$, $\frac{1}{144}$, $\frac{1}{1728}$, etc.

EXCHANGE, the receiving or paying of money in one place for an equal sum in another, by order, draft, or bill of exchange.

FRACTION, any division of a whole number or unit, thus $\frac{3}{4}$, three-fourths, $\frac{1}{5}$, one-fifth.

An *improper fraction* is a fraction whose *numerator* exceeds its *denominator*.

FACTORS, numbers, from the multiplication of which proceeds the product; thus, 3 and 4 are the factors of 12.

FIGURE—A figure is a written sign representing a number.

INTEGER—An *integer* is a whole number or sum.

INTEREST, the price or sum per cent. derived from the use of money lent. *Simple interest* is that which arises from the principal sum only. *Compound interest* is that which arises from the *principal* and *interest* added—*interest* on *interest*.

MATHEMATICS, the science of quantities.

MULTIPLICATION, adding to zero any given number as many times as there are units in the *multiplier*.

MULTIPLIER, the number that *multiplies;* the multiplier *must* be an abstract number.

MULTIPLICAND, the number *multiplied*.

MENSURATION is the art of measuring the areas and solid contents of figures and bodies.

MULTIPLE, a quantity which contains another a certain number of times without a remainder. A *common multiple* of two or more numbers contains each of them a certain number of times, exactly. The *least common multiple* is the *least* number that will do this; 12 is the *least common multiple* of 3 and 4.

NUMBER, a *number* is a unit, or a collection of units. A *prime number* is one that cannot be resolved, or separated into two or more integral factors.

NOTATION, writing numbers.

NUMERATION, reading numbers.

NUMERATOR, the number placed above the line, in fractions; thus, $\frac{5}{9}$ (five-ninths), five is the *numerator*.

POWER—A *power* is the product arising from multiplying a number by itself, or repeating it several times as a factor; thus, $3 \times 3 \times 3$, the product, 27, is a *power* of 3. The *exponent* of a *power* is the number denoting how many times the factor is repeated to produce the *power*, and is written thus: 2^1, 2^2, 2^3.

$2^1 = 2^1 = 2$, the first *power* of 2.
$2 \times 2 = 2^2 = 4$, the second *power* of 2.
$2 \times 2 \times 2 = 2^3 = 8$, the third *power* of 2.

PRINCIPAL, the sum lent on interest, or invested.

PER CENT., from *per centum*, signifying by the hundred; hence, 1 *per cent.* of anything is one-hundredth part of it, 2 *per cent.* is one-fiftieth, etc.

QUADRANGLE, the name of a figure with four sides.

QUANTITY is anything that can be increased, diminished, or measured.

RATIO is the comparison with each other of two numbers of the same kind.

RECIPROCAL is a unit divided by any number. The *reciprocal* of any number or fraction, is that number or fraction inverted; thus the *reciprocal* of $\frac{4}{1}$ is $\frac{1}{4}$, of $\frac{3}{4}$ is ,$\frac{4}{3}$ of $3\frac{1}{3}$ is $\frac{3}{10}$.

RATE PER CENT., the price or sum paid for the use of 100 dollars.

RULE—A *rule* is the prescribed method of performing an operation.

RADIUS, half the diameter of a circle. A right line passing from the center to the circumference.

SUBTRACTION, taking a lesser number from a greater.

SURFACE OR SUPERFICES, the exterior part of anything that has length and breadth.

SUPPLEMENT, the difference of a number and some particular number below it; thus 13, taking 10 as the base, the *supplement* is 3, because the difference of 13 and 10 is 3.

SQUARE, a figure having four equal sides, and four right angles. The product of a number

multiplied by itself; thus 16 is the square of 4. $4 \times 4 = 16$.

SQUARE ROOT is the number which multiplied into itself, produces the number of which it is the *root.* 4 is the *root* of 16; $4 \times 4 = 16$.

SPECIE, coin.

SCALE—A scale is a series of numbers regularly ascending or descending.

A SOLID or BODY has length, breadth and thickness.

SPHERE, a body in which every part of the surface is equally distant from the center.

TRIANGLE, a figure with three sides.

TERM—The *terms* of a fraction are numerator and denominator taken together.

UNIT—A unit is *one thing.*

VERTEX, the top of a pyramid or cone.

ZERO, a cipher, or nothing.

In arithmetic, the answer in each operation has a distinctive name. In addition it is called the *sum*; in subtraction, *difference* or *remainder;* in multiplication, the *product;* in division, the *quotient.*

NOTATION.

All numbers are represented by the ten following figures:

one.	two,	three,	four,	five,	six,	seven.	eight,	nine,	ciph'r.
1,	2,	3,	4,	5,	6,	7,	8,	9,	0.

To establish their significance clearly in the mind of the pupil it will be of great advantage occasionally to write and read them in the following manner:

one one	two-ones	three-ones	four-ones	five-ones	six-ones	seven-ones	eight-ones	nine-ones	no ones
$\frac{1}{1}$	$\frac{2}{1}$	$\frac{3}{1}$	$\frac{4}{1}$	$\frac{5}{1}$	$\frac{6}{1}$	$\frac{7}{1}$	$\frac{8}{1}$	$\frac{9}{1}$	$\frac{0}{1}$

The different values which the same figures have, are called *simple* and *local* values.

The *simple* value of a figure is the value it expresses when it stands alone, or in the right hand place.

The *local* value of a figure is the increased value which it expresses by having other figures placed on its right.

Ten is expressed by combining one and cipher, thus, 10; two and cipher combined make twenty, thus, 20, etc. A hundred is expressed by combining the one and two ciphers, thus, 100; two

hundred thus, 200, etc. Ten ones make a ten; ten tens make a hundred; ten hundreds make one thousand; that is, numbers increase from right to left in a ten-fold ratio. Each removal of a figure one place to the left increases its value ten times.

NUMERATION.

Tredecill'ns.	Duodecil'ns.	Undecilli'ns,	Decillions,	Nonillions,	Octillions,	Septillions,	Sextillions,	Quintillions,	Quadrilli'ns,	Trillions,	Billions,	Millions,	Thousands,	Units,
121,	227,	196,	497,	321,	415,	716,	219,	304,	196,	218,	316,	415,	207,	126.

To read numbers expressed by figures: Point them off into periods of three figures each, commencing at the right hand; then, beginning at left hand, read the figures of each period in the same manner as those of the right hand period are read, and at the end of each period pronounce its name; thus, 121 tredecillions, 227 duodecillions, 196 undecillions, 497 decillions, 321 nonillions, 415 octillions, 716 septillions, 219 sextillions, 304 quintillions, 196 quadrillions, 218 trillions, 316 billions, 415 millions, 207 thousands, 126.

ADDITION.

Various suggestions have been made referring to improved methods of addition. In nearly every case the proposed improvement has been more fanciful than real. In practice, I have found no better or quicker method than the following:

```
 3746
 8743
 6978
 1256
 3021
 ----
23744
```

Commence at the bottom of the right hand column; add thus, 7, 15, 18, 24; set down the 4 in unit's place, and carry the two tens to the second column; then add thus, 4, 9, 16, 24; set down the 4 in ten's place, and carry the two hundreds to the third column, and so on to the end. Never add in this manner: 1 and 6 are seven, and 8 are 15, and 3 are 18, and 6 are 24. It is just as easy to name the *sum* at once, omitting the name of each separate figure, and saves two thirds of time and labor.

Book-keepers and others who have long columns of figures to add will find the following methods and suggestions acceptable and very valuable.

SHORT METHODS OF ADDITION.

Rule of addition for two columns:

$$\begin{array}{r} 24 \\ 86 \\ 31 \\ 19 \\ \hline 160 \end{array}$$

Process — 19 and 31 = 50 and 86 = 136 and 24 = 160.

Rule of addition for three columns:

$$\begin{array}{r} 119 \\ 227 \\ 315 \\ 430 \\ \hline 1091 \end{array}$$

Process—45 and 27 = 72 and 900 = 972 and 119 = 1091.

Any person by practicing these simple methods may become very expeditious.

Fives are always easy to add; so are 9's, when it is borne in mind that adding 9 to a sum places it in the next higher ten with the unit 1 less; thus, $17 + 9 = 26$; $39 + 9 = 48$; $63 + 9 = 72$.

8
4
7^2
9
6
5
8
7
9
4
6
8
7
9
8
9

In adding long columns of figures, write in the margin, lightly with pencil, opposite the last figure added, the unit figure of the sum immediately exceeding 100. By doing this the mind is never burdened with numbers beyond 100; and if interrupted in the work, it can be resumed at the stage at which the interruption occurred. The example in the margin shows the method; opposite the figure 7; the 2 indicating the column, so far, with the 7 included, amounts to 102.

INSTANTANEOUS ADDITION BY COMBINATION.

Write two, three, four, or more rows of miscellaneous figures, then write such figures as will make an equal number of nines in each column; under these again, write another row of miscellaneous figures.

EXAMPLE—

4 9 8 7
4 7 3 6
2 1 8 7
5 0 1 2 one 9.
5 2 6 3 two 9's.
7 8 1 2 three 9's.

3 4 9 8 ~~6~~
3

These first three rows are miscellaneous; the next three are the complement of the first, taking 9 as the base, making the seventh row miscellaneous.

RULE.—To the last row prefix the number of nines, and subtract the number of nines; read 34983.

The foregoing is a very entertaining and profitable exercise for developing the calculating faculty.

MULTIPLICATION.

The base of our system of notation is 10; therefore numbers increase and diminish in a tenfold ratio; increasing from the decimal point to the left, and decreasing from the decimal point to the right; hence to multiply any number by 10, annex a cipher, or remove the point one place to the right. To multiply any number by 100, annex two ciphers, or remove the point two places to the right. To multiply any number by 1000, annex three ciphers, or remove the point three places to the right.

To find the product of two numbers, when the multiplicand and the multiplier each contain but two figures.

EXAMPLE 1—

$$\begin{array}{r} 3\,3 \\ 2\,2 \\ \hline 7\,2\,6 \end{array}$$

EXPLANATION—set down the smaller factor under the larger, units under units, tens under tens. Multiply the units of the multiplicand by the unit figure of the multiplier; thus, $2 \times 3 = 6$, set the 6 down in unit's place; multiply the tens in the multiplicand by the unit figure in the multiplier, and the units in the multiplicand by the tens figure in the multiplier; thus, $3 \times 2 = 6$, and $3 \times 2 = 6$, add these two products together; 6 and 6 are 12; set down 2, carrying the ten to the next product, then multiply the tens in the multiplicand by the tens in the multiplier; thus, $3 \times 2 = 6$; add the one carried from the last product, making the whole product 726.

The same method can be applied when the multiplicand has three or more figures.

EXAMPLE 2—

$$\begin{array}{r} 1\,6\,3 \\ 2\,4 \\ \hline 3\,9\,1\,2 \end{array}$$

The steps are: $3 \times 4 = 12$, set down the 2 and carry the 1; $6 \times 4 + 3 \times 2 + 1 = 31$; set down the 1, and carry the 3. $1 \times 4 + 6 \times 2 + 3 = 19$; set down 9 and carry 1; $1 \times 2 + 1 = 3$, which place at the head of the line, making a total of 3912.

When the multiplier can be resolved into two factors, it is sometimes shorter to multiply by each factor, than by the whole number.

EXAMPLE, multiply 163 by 24,
$8 \times 3 = 24$,

```
 163
   8
----
1304
   3
----
3912. Ans.
```

When the multiplier is any number between 11 and 20, the process is simply to multiply by the unit of the multiplier, set down the product under, and one place to the right *of*, and then add *to* the *multiplicand.*

EXAMPLE, multiply 1496 by 17.

```
 1496
 10472
 -----
 25432. Ans.
```

or thus:

```
 1496
   17
 -----
 25432
```

The process in the last example is:

$6 \times 7 = 42$, set down 2 and carry 4.
$9 \times 7 + 6 + 4 = 73$; carry 7.
$4 \times 7 + 9 + 7 = 44$; carry 4.
$1 \times 7 + 4 + 4 = 15$; carry 1.
$1 + 1 = 2$.

To multiply two figures by 11.

RULE.—Between the two figures write their sum: thus; multiply 43 by 11. Ans, 473. The sum of

4 and 3 is 7; place the seven between the 4 and 3, for the product.

To multiply any number by 11.

RULE.—Bring down the extreme right hand figure, then add the right hand figure to the next, and bring down the sum then add the second figure to the third and bring down the sum adding in the figure carried, in each case, and so on to the end.

EXAMPLE—

$$\begin{array}{r} 12345678 \\ 11 \\ \hline 135802458 \end{array}$$

Process—8 brought down:

$8 + 7 = 15$, set down 5 and carry 1.
$7 + 6 + 1$, carried, $= 14$, set down 4, carry 1.
$6 + 5 + 1$, carried, $= 12$, set down 2, carry 1.
&c.

To multiply when the unit figures added, equal 10, *and the tens are alike, as* 67×63.

RULE.—Multiply the units and set down the result, then add one to the upper number in tens place, and multiply by the lower.

EXAMPLE—

$$\begin{array}{r} 67 \\ 63 \\ \hline 4221 \end{array}$$

The steps are: $7 \times 3 = 21$
$7 \times 6 = 42$

What is the cost of 26 yds of ribbon at 24 cents per yd. Ans. $6.24.

Multiply 86 by 84. Ans. 7224.
Multiply 38 by 32. Ans. 1216.
Multiply 77 by 73. Ans. 5621.

When the method of squaring numbers is learned, the following rapid method of multiplying may be used:

RULE.—To find the product of two numbers, square their mean and deduct the square of half their difference, the result will be the answer.

NOTE. The mean of two numbers is the number equidistant between them.

EXAMPLE.—Multiply 22 by 18. Ans. 396.

Process.—The mean, or the number equidistant, is 20, the square of 20 is 400, half the difference is 2, the square of 2 is 4; deducted from 400 leaves 396, the answer. Practice the rule with the following and similar examples until expertness is acquired:

19 times 21, 18 times 22, 17 times 23, 16 times 24, 15 times 25, 14 times 26, 29 times 31, 28 times 32, &c. 79 times 81, 78 times 82, &c.

To multiply two numbers when either have one or more ciphers on the right, as 26 *by* 20, 244 *by* 200, *&c.*

RULE.—Take the cipher or ciphers from one number and annex it, or them, to the other, multiply by the number expressed by the remaining figures.

EXAMPLE 1.—Multiply 26 by 20. Ans. 520.

Process.—$260 \times 2 = 520$.
2.—Multiply 244 by 200. Ans. 48800.
$24400 \times 2 = 48800$.

LIGHTNING METHOD OF SQUARING NUMBERS.

BY COMPLEMENT AND SUPPLEMENT.

RULE.—For squaring by SUPPLEMENT. To the number to be squared, add the *supplement*, multiply the sum by the *base*, to the product add the *square* of the supplement, and the sum will be the answer.

NOTE. Take the nearest convenient number that can be divided by 10, without a remainder, for the *base*, the surplus will be the *supplement*.

EXAMPLE 1.—What is the square of 11? Ans. 121.

Process.—Taking 10 for the base, the difference or supplement is $1 + 11 \times 10 + 1^2 = 121$.

2.—	$12^2 =$	144
3.—	$13^2 =$	169
4.—	$18^2 =$	324
5.—	$(101)^2 =$	10201
6.—	$(104)^2 =$	10816
7.—	$(106)^2 =$	11236
8.—	$(109)^2 =$	11881
9.—	$(1003)^2 =$	1,006,009
10.—	$(1005)^2 =$	1,010,025
11.—	$(1007)^2 =$	1,014,049
12.—	$(1047)^2 =$	1,096,209

NOTE. Until this rule is thoroughly understood, the learner should limit his exercises to numbers near 10, 100, 1000, &c.; and then operate with more complex numbers, as under:

$$1.— (22)^2 = 484.$$

Process.—Taking 20 for the base, the supplement is, $2 + 22 \times 20 + 2^2 = 484.$

2.— $(33)^2 =$	1089
3.— $(47)^2 =$	2209
4.— $(56)^2 =$	3136
5.— $(68)^2 =$	4624
6.— $(71)^2 =$	5041
7.— $(82)^2 =$	6724
8.— $(93)^2 =$	8649
9.—$(203)^2 =$	41,209
10.—$(322)^2 =$	103,684
11.—$(796)^2 =$	633,616

For squaring numbers by the complement.

RULE.—From the number to be squared *subtract* the complement, *multiply* the result by the base, to the product *add* the square of the complement.

$$1. (9)^2 = 81.$$

Process.—Taking 10 for the base, the difference or complement is 1, then $9 - 1 \times 10 + 1^2 = 81,$

2.—	$(8)^2 =$	64
3.—	$(19)^2 =$	361
4.—	$(27)^2 =$	729
5.—	$(91)^2 =$	8281
6.—	$(93)^2 =$	8649
7.—	$(96)^2 =$	9216
8.—	$(99)^2 =$	9801
9.—	$(993)^2 =$	986,049
10.—	$(994)^2 =$	988,036
11.—	$(997)^2 =$	994,009
12.—	$(9954)^2 =$	99,082,116
13.—	$(9947)^2 =$	98,942,809
14.—	$(99946)^2 =$	9,989,202,916
15.—	$(99957)^2 =$	9,991,401,849

Note. In squaring numbers between 50 and 60, take 50 for the base; to 25 add the supplement, call the sum hundreds, to this add the square of the supplement.

1.—$(51)^2 = 2601$.
Process.—$25 + 1 = 2600 + 1^2 \times = 2601$.
2.—$(52)^2 = 2704$.

Note. In squaring numbers between 40 and 50; to 15 add the unit figure, call the number hundreds, to the sum add the square of the complement, taking 50 for the base.

1.—$(41)^2 = 1681$.
Process.—$15 + 1 = 1600 + 9^2 = 1681$.
2.—$(42)^2 = 1764$.
3.—$(43)^2 = 1849$.

To multiply any two numbers together, ending with ½, as 9½ by 3½.

RULE.—To the product of the whole numbers, add half their sum, plus $\frac{1}{4}$.

NOTE. When the *sum* is an odd number take half the next number below it, and the fraction in the answer will be $\frac{3}{4}$.

1. What will $9\frac{1}{2}$ lbs. of rice cost, at $3\frac{1}{2}$ cts. per lb? Ans. $33\frac{1}{4}$ cents.

Process.—The sum of 9 and 3 is 12; half this sum is 6; then we say 9 times 3 is 27, and 6 is 33; to this add $\frac{1}{4}$.

2. What will $9\frac{1}{2}$ doz. buttons cost, at $8\frac{1}{2}$ cts. per doz? Ans. $80\frac{3}{4}$ cts.

3. What will $11\frac{1}{2}$ lbs. of beef cost, at $9\frac{1}{2}$ cents per lb? Ans. \$1.09$\frac{1}{4}$.

4. What will $7\frac{1}{2}$ doz. eggs cost, at $13\frac{1}{2}$ cents per doz? Ans. \$1.01$\frac{1}{4}$.

To multiply any two numbers together having the same fraction.

RULE.—To the product of the whole numbers, add the product of their sum by the fraction; to this add the product of the fractions.

1. What will $13\frac{3}{4}$ lbs. of beef cost, at $7\frac{3}{4}$ cents per lb? Ans. \$1.06$\frac{9}{16}$.

Process.—The sum of 13 and 7 is 20, three-fourths of this sum is 15, so we say, 7 times 13 is 91, and 15 is 106, to which add the product of the fractions, ($\frac{9}{16}$) and the result is the Ans. \$1.06$\frac{9}{16}$.

2. What will $12\frac{1}{4}$ lbs. of rice cost, at $6\frac{1}{4}$ cents per lb? Ans. $76\frac{9}{16}$. cents.

3. What will $27\frac{3}{4}$ yds. of cloth cost, at $\$3\frac{3}{4}$ per yard? Ans. $\$104\frac{1}{16}$.

3. What will $12\frac{3}{5}$ ft. of lumber cost, at $8\frac{2}{5}$ cts. per foot? Ans. $\$1.04\frac{4}{25}$.

5. What will $13\frac{5}{8}$ lbs. of cheese cost, at $11\frac{5}{8}$ cts. per lb.? Ans. $\$1.58\frac{25}{64}$.

6. What will $19\frac{1}{4}$ lbs. of beef cost, at $14\frac{1}{4}$ cents per lb. Ans. $\$2.74\frac{5}{16}$.

FRACTIONS.

GENERAL PRINCIPLES OF FRACTIONS.

Multiplying the numerator, multiplies the fraction.

Dividing the numerator, divides the fraction.

Multiplying the denominator, divides the fraction.

Dividing the denominator, multiplies the fraction.

Multiplying or *dividing* both terms of the fraction by the same number, does not change its value.

Fractions are called similar when they have a common denominator, as $\frac{4}{5}$, $\frac{3}{5}$, $\frac{2}{5}$, $\frac{1}{5}$.

Dissimilar fractions are fractions that are not alike, as $\frac{3}{5}$, $\frac{4}{7}$, $\frac{2}{5}$, $\frac{7}{8}$.

The numerators of similar fractions only can be added.

The common denominator is written under the sum or difference.

To reduce a fraction to its simplest form.

RULE.—Divide both terms by their greatest common divisor or its factors, the simplest form, or lowest term of $\frac{36}{48}$, is obtained by dividing both terms by 12, $\frac{36}{48} = \frac{3}{4}$.

To find the greatest common factor or divisor.

RULE.—Separate the numbers into their prime factors; the product of all the factors that are common will be the greatest common divisor.

1. What is the greatest common divisor of 12 and 48? Ans. 6.

Process—Separating the numbers into their prime factors, we have $12 = 6 \times 2$; $48 = 6 \times 8$, hence 6 is the greatest common factor or divisor of the two numbers.

2. What is the greatest common divisor of 14 and 42? Ans. 7.
3. What is the greatest common divisor of 5 and 75? Ans. 5.
4. What is the greatest common divisor of 4, 8, 12 and 16? Ans. 4.
5. What is the greatest common divisor of 12, 24, 18 and 36? Ans. 6.

To find the least common multiple.

RULE.—Take the product of all the prime factors of that number having the greatest number of prime factors, and this with those prime factors of the other numbers, not found in the factors of the number taken, will be the least common multiple.

1. What is the least common multiple of 4 and 6? Ans. 12.

Process, $2 \times 2 = 4$; $2 \times 3 = 6$; $2 \times 2 \times 3 = 12$, the least common multiple.

2. What is the least common multiple of 18 and 36? Ans. 36.

3. What is the least common multiple of 4, 6, 8, 10? Ans. 120.

4. What is the least common multiple of 2, 3, 4, 5, 6? Ans. 60.

5. What is the least common multiple of 2, 4, 6, 9 and 18? Ans. 36.

ADDITION OF FRACTIONS.

RULE.—Make the fractions similar by reducing them to the same denominator; add the numerators, and place the sum over the common denominator.

1. What is the sum of $\frac{2}{3}$ and $\frac{1}{4}$? Ans. $\frac{11}{12}$.
2. What is the sum of $\frac{3}{5}$ and $\frac{1}{2}$? Ans. $1\frac{1}{10}$.
3. What is the sum of $\frac{1}{3}$, $\frac{3}{4}$ and $\frac{1}{2}$? Ans. $1\frac{7}{12}$.
4. What is the sum of $\frac{7}{8}$ and $\frac{5}{9}$? Ans. $1\frac{31}{72}$.
5. What is the sum of $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{5}$?. Ans. $1\frac{47}{60}$.

SUBTRACTION OF FRACTIONS.

RULE.—Make the fractions similar by reducing them to the same denominator, and write the difference of the numerators over the common denominator.

1. From $\frac{3}{4}$ take $\frac{1}{2}$. Ans. $\frac{1}{4}$.

Process, $\frac{1}{2} = \frac{2}{4}$, $\frac{3}{4} - \frac{2}{4} = \frac{1}{4}$.

2. From $9\frac{1}{8}$ take $4\frac{1}{2}$. Ans. $4\frac{5}{8}$.
3. From $8\frac{1}{2}$ take $3\frac{1}{4}$. Ans. $5\frac{1}{4}$.
4. From $18\frac{3}{4}$ take $3\frac{1}{3}$. Ans. $15\frac{5}{12}$.

MULTIPLICATION OF FRACTIONS.

RULE.—Multiply the numerators together for a new numerator, and the denominators together for a new denominator.

EXAMPLE.—Multiply $\frac{7}{8}$ by $\frac{2}{5}$.

$$\frac{7}{8} \times \frac{2}{5} = \frac{14}{40} = \frac{7}{20}.$$

General rule for multiplying fractions and all mixed numbers.

RULE.—Multiply the whole numbers together, then multiply the upper whole number by the lower fraction, then multiply the upper fraction by the lower whole number, then multiply the fractions together, and add all the products together.

1. Multiply $8\frac{1}{2}$ by $4\frac{1}{3}$. Ans. $36\frac{5}{6}$.

Process,

$$
\begin{array}{r@{\;}l}
 & 8\frac{1}{2} \\
 & 4\frac{1}{3} \\
\hline
8 \times 4 = & 32 \\
8 \times \frac{1}{3} = & 2\frac{2}{3} \\
\frac{1}{2} \times 4 = & 2 \\
\frac{1}{2} \times \frac{1}{3} = & \frac{1}{6} \\
\hline
 & 36\frac{5}{6} \text{ Ans.}
\end{array}
$$

2. What will $17\frac{5}{8}$ yards of tape cost at $7\frac{3}{4}$ cents per yard? Ans. \$1.36$\frac{19}{32}$.

3. What will $73\frac{7}{8}$ acres of land cost at $9\frac{3}{4}$ dollars per acre? Ans. \$720$\frac{9}{32}$.

4. What will $16\frac{1}{3}$ acres of land cost at $3\frac{1}{4}$ dollars per acre? Ans. \$53$\frac{1}{12}$.

NOTE.—A very little practice with this rule will enable the learner to do the work mentally, without setting down partial products. In the last example, he would simply say 3 times 16 is 48, $\frac{1}{4}$ of 16 is 4, making 52, and 3 times $\frac{1}{3}$ is 1, making 53, and $\frac{1}{3} \times \frac{1}{4}$ is $\frac{1}{12}$, making a total of $53\frac{1}{12}$ dollars.

In actual business, abbreviate by omitting the fractions in the products, and taking the nearest units; if one-half occurs twice, count one, and perform the last example thus,

$$
\begin{array}{r@{\;}r}
16 \times 3 = & 48 \\
16 \times \frac{1}{4} = & 4 \\
\frac{1}{3} \times 3 = & 1 \\
\hline
 & 53
\end{array}
$$

The answer will be only $\frac{1}{12}$ wrong.

When the whole numbers are alike, and the sum of the fractions is a unit.

RULE.—Take the *product* of the whole numbers, to this add the *integer* in the multiplicand, then add the *product* of the fractions, and the result will be the answer.

1. Multiply $2\frac{1}{2}$ by $2\frac{1}{2}$. Ans. $6\frac{1}{4}$.

Process—$2 \times 2 + 2 = 6 + \frac{1}{2} \times \frac{1}{2} = 6\frac{1}{4}$.

2. $3\frac{1}{3} \times$ by $3\frac{2}{3} = 12\frac{2}{9}$.
3. $7\frac{7}{8} \times 7\frac{1}{8} = 56\frac{7}{64}$.
4. $9\frac{5}{8} \times 9\frac{3}{8} = 90\frac{15}{64}$.
5. $19\frac{5}{8} \times 19\frac{3}{8} = 380\frac{15}{64}$
6. $101\frac{4}{5} \times 101\frac{1}{5} = 10302\frac{4}{25}$.
7. $109\frac{9}{13} \times 109\frac{4}{13} = 11990\frac{36}{169}$.
8. $98\frac{9}{14} \times 98\frac{5}{14} = 9702\frac{45}{196}$.
9. $96\frac{7}{9} \times 96\frac{2}{9} = 9312\frac{14}{81}$.
10. $9947\frac{11}{17} \times 9947\frac{6}{17} = 98952756\frac{66}{289}$.
11. $99957\frac{28}{37} \times 99957\frac{9}{37} = 9{,}991{,}501{,}806\frac{252}{1369}$.

The Author of this book claims to be the sole inventor of the above rule. When the learner has mastered our method of squaring numbers, he will be able, with this rule, to find the answers to all such problems, with wonderful and startling rapidity.

Where the multiplier is the aliquot part of 100 *or* 1000, *the following table will be useful:*

$12\frac{1}{2}$ is $\frac{1}{8}$ part of 100.	$8\frac{1}{3}$ is $\frac{1}{12}$ part of 100
25 is $\frac{2}{8}$ or $\frac{1}{4}$ of 100.	$16\frac{2}{3}$ is $\frac{2}{12}$ or $\frac{1}{6}$ of 100
$37\frac{1}{2}$ is $\frac{3}{8}$ part of 100.	$33\frac{1}{3}$ is $\frac{4}{12}$ or $\frac{1}{3}$ of 100
50 is $\frac{4}{8}$ or $\frac{1}{2}$ of 100.	$66\frac{2}{3}$ is $\frac{8}{12}$ or $\frac{2}{3}$ of 100
$62\frac{1}{2}$ is $\frac{5}{8}$ part of 100.	$83\frac{1}{3}$ is $\frac{10}{12}$ or $\frac{5}{6}$ of 100
75 is $\frac{6}{8}$ or $\frac{3}{4}$ of 100.	125 is $\frac{1}{8}$ part of 1000
$87\frac{1}{2}$ is $\frac{7}{8}$ part of 100.	250 is $\frac{2}{8}$ or $\frac{1}{4}$ of 1000
$6\frac{1}{4}$ is $\frac{1}{16}$ part of 100.	375 is $\frac{3}{8}$ part of 1000
$18\frac{3}{4}$ is $\frac{3}{16}$ part of 100.	625 is $\frac{5}{8}$ part of 1000
$31\frac{1}{4}$ is $\frac{5}{16}$ part of 100.	875 is $\frac{7}{8}$ part of 1000

To multiply by the aliquot part of 100.

Note.—If the multiplicand is a mixed number, reduce the fraction to a decimal.

Rule.—Multiply by 100, by annexing two ciphers; such part of the product as the multiplier is part of 100 will be the answer.

Example.—Multiply 86 by $12\frac{1}{2}$. Ans. 1075.

Process—$8600 \div 8 = 1075$.

To multiply	by	$6\frac{1}{4}$,	annex	two	0s;	divide by	16
"	"	$6\frac{2}{3}$,	"	"	"	"	15
"	"	$8\frac{1}{3}$,	"	"	"	"	12
"	"	$12\frac{1}{2}$,	"	"	"	"	8
"	"	$16\frac{2}{3}$,	"	"	"	"	6
"	"	25	"	"	"	"	4
"	"	20	"	"	"	"	5
"	"	$33\frac{1}{3}$,	"	"	"	"	3
"	"	50	"	"	"	"	2

To	multiply	by 125	annex	three	0s;	divide by	8
“	“	$333\frac{1}{3}$	“	“	“	“	3
“	“	$66\frac{2}{3}$	“	“	“	“	15
“	“	$83\frac{1}{3}$	“	“	“	“	12
“	“	$62\frac{1}{2}$	“	“	“	“	16
“	“	$31\frac{1}{4}$	“	“	“	“	32
“	“	$166\frac{2}{3}$	“	“	“	“	6
“	“	$1\frac{1}{4}$	“	one	“	“	8
“	“	$2\frac{1}{2}$	“	“	“	“	4
“	“	$3\frac{1}{3}$	“	“	“	“	3
“	“	$1\frac{2}{3}$	“	“	“	“	6

DIVISION OF FRACTIONS.

RULE.—Reduce whole and mixed numbers to the form of an improper fraction. Multiply the dividend by the divisor inverted.

1. Divide 8 by $1\frac{1}{4}$. Ans. $6\frac{2}{5}$.

Process—$1\frac{1}{4}$ inverted is $\frac{4}{5} \times \frac{8}{1} = \frac{32}{5} = 6\frac{2}{5}$.

2. Divide 6 by $\frac{1}{2}$. Ans. 12.
3. Divide 8 by $\frac{1}{4}$. Ans. 32.
4. Divide $8\frac{1}{2}$ by $7\frac{1}{4}$. Ans. $1\frac{5}{29}$.
5. Divide $7\frac{1}{2}$ by $2\frac{1}{3}$. Ans. $3\frac{3}{14}$.

To divide by $3\frac{1}{3}$: Remove the decimal point one place to the left, and multiply by 3.

To divide by $2\frac{1}{2}$: Remove the point one place to the left, and multiply by four.

To divide by 5: Remove the point one place to the left, and multiply by 2.

To divide by $12\frac{1}{2}$: Remove the point two places to the left, and multiply by 8.

To divide by 25: Remove the point two places to the left, and multiply by 4.

To divide by $33\frac{1}{3}$: Remove the point two places to the left, and multiply by 3.

To divide by 50: Remove the point two places to the left, and multiply by 2.

To divide by $66\frac{2}{3}$: Remove the point two places to the left, multiply by 3 and divide by 2.

To divide a number by a fraction having 10 *for the numerator.*

RULE.—Multiply by the denominator and remove the point one place to the left.

Divide 7 5 0 by $1\frac{1}{9}$. Ans. 675.

$$\begin{array}{r} 750 \\ 9 \\ \hline \text{Ans. } 675.0 \end{array}$$

Divide 4 7 0 by $1\frac{3}{7}$. Ans. 329.

$$\begin{array}{r} 470 \\ 7 \\ \hline 329.0 \end{array}$$

To divide any number by a fraction having 100 *for its numerator.*

RULE.—Multiply by the denominator and remove point two places to the left.

ADDITION AND SUBTRACTION OF DECIMALS

Are performed in the same manner as in whole numbers; care being taken to properly point off the decimal places.

MULTIPLICATION OF DECIMALS.

Rule.—Multiply as in whole numbers, and point off as many places to the left for decimals as there are decimal places in both factors.

1. Multiply .5 by .5. Ans. .25.
2. Multiply 1.75 by .3. Ans. .525.
3. 27.46 by .4 Ans. 10,984.

To multiply by .1 remove the decimal point *one* place to the *left*, by .01 *two* places, by.001 *three* places, by 10 *one* place to the right,by 100 *two* places, by 1000 *three* places, &c., &c.

Note.—In practical business the answer to *three* decimal places is sufficiently exact, the *third* decimal only counting for mills, the drudgery of finding, and writing the figures for decimals of no value, may be avoided by reversing the order of the multiplier and writing the first figure of the reversed multiplier under the third decimal figure in the multiplicand, begin each line of the partial products, with the product of the multiplying figure and the figure directly above it, adding the carrying figure, if any, from the immediate right hand figure.

What is the par value in American gold coin of £11 ,, 4 ,, 3, Sterling?

£11.2125	11.2125
4.8665	56 684
560625	44 850
672750	8 970
672750	673
897000	67
448500	5
$54.56563125	$54.565

This example illustrates the difference of the two methods.

When there are not as many figures in the product as there are decimals in both factors, supply the deficiency by prefixing ciphers.

1. Multiply .3 by .3. Ans. .09.
2. Multiply .29 by .004. Ans. .00116.

DIVISION OF DECIMALS.

The division of decimals is performed in the same manner as in whole numbers, care being taken to point off the decimal places in the quotient.

RULE.—Divide as in whole numbers, and point off in the quotient as many places to the left for decimals as the decimal places in the dividend exceed those in the divisor.

Divide .244 by .4. Ans. .61.
Divide .255 by .05. Ans. 5.1.

The learner can supply additional examples at discretion, bearing in mind the following: The *dividend* must always contain, at least, as many decimal places as the *divisor*. When the number of figures in the quotient is less than the excess of the decimal places in the *dividend* over those in the *divisor*, the deficiency must be supplied by prefixing ciphers. When there is a remainder after dividing the dividend, annex ciphers, and continue the division; the ciphers annexed are decimals to the dividend.

RAPID

RULES FOR FARMERS.

The practice of buying or selling grain by the 100 pounds, or the *cental* system, is becoming almost universal, and has many advantages over the bushel.

The following rules for finding the relative values of the bushel and the cental are easy to learn, and true and rapid in execution.

To find the value per cental when the price per bushel is given.

RULE.—Set down the price per bushel; remove the decimal point two places to the right, and divide by the number of pounds in the bushel.

EXAMPLE.—If wheat is $1.80 per bushel, what is its value per cental? Ans. $3.

Process— $60\overline{)180}$

$$\underline{}$$
$$3$$

To find the value per bushel when the price per cental is given.

RULE.—Set down the price per cental; multiply by the number of pounds in the bushel, and remove the decimal point two places to the left.

EXAMPLE.—If wheat is $3.00 per cental, what is the value of a bushel? Ans. 1.80.

Process—

$$\begin{array}{r} 3.000 \\ 6 \\ \hline 1.8000 \end{array}$$

RAPID RULE FOR RECKONING THE COST OF HAY.

RULE—Multiply the number of pounds by half the price per ton, and remove the decimal point three places to the left.

EXAMPLE.—What is the cost of 764 lbs. of hay at $14 per ton? Ans. $5.348.

Process—

$$\begin{array}{rr} & 764 \\ 14 \div 2 = & 7 \\ \hline & 5.348 \end{array}$$

NOTE.—The above rule applies to anything of which 2,000 pounds is a ton.

To Measure Grain.

RULE.—Level the grain; ascertain the space it occupies in cubic feet; multiply the number of cubic feet by 8, and point off one place to the left.

EXAMPLE.—A box level full of grain is 20 feet long, 10 feet wide, and 5 feet deep. How many bushels does the box contain? Ans. 800 bush.

Process—$20 \times 10 \times 5 = 1000 \times 8 \div 10 = 800.$

Or,

$$\begin{array}{r} 1\,0\,0\,0 \text{ ft.} \\ 8 \\ \hline 8\,0\,0.0 \end{array}$$

NOTE.—Exactness requires the addition to every one hundred bushels of 44 extra bushel.

The foregoing rule may be used for finding the number of gallons, by multiplying the number of bushels by 8.

If the corn in the box is in the ear, divide the answer by 2, to find the number of bushels of shelled corn, because it requires two bushels of ear corn to make one of shelled corn.

RAPID RULES FOR MEASURING LAND WITHOUT INSTRUMENTS.

In measuring land, the first thing to ascertain is the contents of any given plot in square yards; then, given, the number of yards, find out the number of rods and acres.

The most ancient and simplest measure of distance is a step. Now, an ordinary-sized man can train himself to cover 1 yard at a stride, on the average, with sufficient accuracy for ordinary purposes.

To make use of this means of measuring distances, it is essential to walk in a straight line; to do this, fix the eye on two objects in a line straight ahead, one comparatively near, the other remote;

and, in walking, keep these objects constantly in line.

Farmers and others by adopting the following simple and ingenious contrivance, may always carry with them the scale to construct a correct yard measure.

Take a foot rule, and commencing at the base of the little finger of the left hand, mark the quarters of the foot on the outer borders of the left arm, pricking in the marks with indelible ink.

To find the area of all four-sided figures, two of whose sides are parallel.

RULE.—Multiply the length and the breadth together, and the product is the area.

To find the area of a square, square one of its sides.

RULE.—When the length of two opposite sides is unequal, add them together, and take half the sum.

EXAMPLE 1. How many square yards in a square piece of land, 101 feet on each side?

Process—$101^2 =$ Ans. 10,201 yards.

EXAMPLE 2. How many yards in a piece of land 60 yards long and 20 yards wide? Ans. 1200.

Process—$600 \times 2 = 1200$.

EXAMPLE 3. How may yards in a piece of land, one side is 40 yards long, and the other side 60 yards long, parallel sides being 10 yards apart?

$$\text{Process,} \qquad \frac{40 + 60 \times 10}{2} = 500.$$

500 yards, Ans.

To find the area of all three-sided figures.

RULE.—Multiply the longest side into one-half the distance from this side to the opposite angle.

EXAMPLE.—What is the area of a triangular plot of land, the longest side of which is 80 yards, and the shortest distance from this side to the opposite angle 40 yards?

$$\text{Process,} \quad \frac{40}{2} = 20, 80 \times 20 = 1600 \text{ yds. Ans.}$$

To find how many rods in length will make an acre, the width being given.

RULE.—Divide 160 by the width, and the quotient will be the answer.

EXAMPLE.—If a piece of land be 4 rods wide, how many rods in length will make an acre?

$$160 \div 4 = 40 \text{ rods Ans.}$$

To find the number of acres in any plot of land, the number of rods being given.

RULE.—Divide the number of rods by 8, and the quotient by 2, and remove the decimal point one place to the left.

EXAMPLE.—In 6840 rods how many acres?

$42\frac{3}{4}$ acres Ans.

Process,

$$\begin{array}{r} 8\overline{)6840} \\ 2\overline{)855} \\ 42.75 \end{array}$$

In some cases the method of cancelling may be applied with advantage.

EXAMPLE.—A square plot of land measures 48 rods on each side, how many acres? $14\frac{4}{10}$.

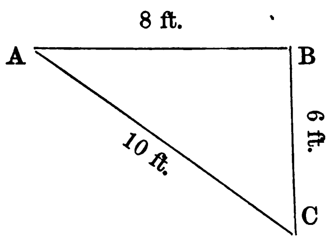
Process—Cancel by dividing each of the upper terms by the lower terms.

$$\begin{array}{c} 6 \times 24 = 144. \\ \dfrac{\cancel{48} \times \cancel{48}}{\cancel{8} \times \cancel{2}} \end{array}$$

RAPID

RULES FOR MECHANICS.

To lay off a square corner.—Measure off eight feet from the end of one sill, and there make a mark; then measure off six feet on the sill lying at right angles with the first, and make another mark; then lay on a ten foot pole, one end of it squarely with the first mark. Move the sill in or out until it exactly squares with it. The figure thus made in marking off the sills, and in the laying down the ten foot pole is a right angle triangle.



Another method for laying off a square corner.

Take a measure and lay off with it a triangle, one side of which is four feet long, another three feet, and the remaining side five feet. This triangle will be right angled, and the two shorter sides will serve to lay off an exact square.

To Measure Grindstones.

Grindstones are measured by the cubic foot, 24 inches diameter, by 4 inches in thickness, is 1728 cubic inches, or 1 cubic foot.

RULE.—Add the diameter to half the diameter, multiply the sum by the same half, multiply the product by the thickness, divide the last product by 1728, for the answer.

EXAMPLE.—How many feet in a grindstone 24 inches in diameter, and 4 inches thick?

Ans. 1 foot.

Process—$24 + 12 \times 12 \times 4 = 1728$ inches.

Measure of Superfices and Solids.

Superficial measure is that which relates to length and breadth only, not regarding thickness. It is made up of squares, either greater or less, according to the different measures by which the dimensions of the figure are taken or measured. Land is measured in this way, its dimensions being taken in inches, feet and yards, or links, rods and acres. The contents of boards also, are found in this way, their dimensions being taken in feet and inches. The standard of measure is as follows: 12 inches in length make one foot of long measure; therefore, $12 \times 12 = 144$, the square inches in a superficial foot.

1. If the floor of a room be 20 feet long by 18 feet wide, how many square feet are contained in it? Ans. 360 feet.

Process—$180 \times 2 = 360$.

2. If a board be 4 inches wide, how much in length will make a foot square? Ans. 36 inches.

Process—144 divided by the width, thus, $\frac{144}{4} = 36$.

3. If a board be 21 feet long and 18 inches broad, how many square feet are contained in it? Ans. $31\frac{1}{2}$ sq. ft.

Process—Multiply the length in feet by the breadth in inches, and divide the product by 12.

$$\frac{21 \times \overset{3}{\cancel{18}}}{\underset{2}{\cancel{12}}} = 31\tfrac{1}{2}.$$

Or thus, 18 inches equals $1\frac{1}{2}$ ft.; $21 \times 1\frac{1}{2} = 31\frac{1}{2}$.

To measure a board wider at one end than the other, of a true taper.

Rule.—Add the widths of both ends together; halve the sum for the mean width, and multiply the mean width by the length.

EXAMPLE.—How many square feet in a board 20 feet long, 9 inches in width at one end, and 11 inches at the other? Ans. $16\frac{2}{3}$ sq. ft.

Process—

$$\frac{9 + 11}{2} = 10 \text{ in., mean width; } \frac{20 \times 10}{12} = 16\tfrac{2}{3}.$$

To find the board measure of planks and joists.

RULE.—Find the contents of one side of the plank or joist by the preceding rule, and multiply the result by the thickness in inches.

EXAMPLE.—What is the board measure of a plank 18 feet long, 10 inches wide, and 4 inches thick? Ans. 60 ft.

Process— $$\frac{18 \times 10}{12} = 15 \times 4 = 60.$$

The diameter being given, to find the circumference.

RULE.—Multiply the diameter by $3\frac{1}{7}$.

EXAMPLE.—What is the circumference of a wheel the diameter of which is 42 inches? Ans. 11 ft.

Process— $$\frac{\overset{3\frac{1}{2}}{\cancel{42}} \times 3\frac{1}{7}}{\cancel{12}} = 11 \text{ feet.}$$

To find the diameter when the circumference is given.

RULE.—Divide the circumference by $3\frac{1}{7}$.

EXAMPLE.—What is the diameter of a wheel, the circumference of which is 11 feet? Ans. $3\frac{1}{2}$ feet.

Process— $$\frac{\cancel{11}}{1} \times \frac{7}{\underset{2}{\cancel{22}}} = 3\tfrac{1}{2}$$

What is the width of a circular pond, 154 rods in circumference? 49 rods Ans.

Process— $$\frac{\overset{7}{\cancel{154}}}{1} \times \frac{7}{\cancel{22}} = 49.$$

To find how many solid feet a round stick of timber of the same thickness throughout, will contain when squared.

RULE.—Square half the diameter in inches, multiply by 2, multiply by the length in feet, and divide the product by 144.

EXAMPLE.—How many solid feet, when squared, in a round log, 24 inches wide and 10 feet long?

Ans. 20 feet.

Process— $$\frac{\cancel{144} \times 2 \times 10}{\cancel{144}} = 20.$$

General rule for measuring timber, to find the solid contents in feet.

RULE.—Multiply the depth in inches by the breadth in inches, and then multiply by the length in feet, and divide by 144.

EXAMPLE.—How many solid feet in a piece of timber 24 inches wide, 10 inches thick, and 12 feet long? 20 feet Ans.

Process— $$\frac{\overset{2}{\cancel{24}} \times 10 \times \cancel{12}}{\underset{\cancel{12}}{\cancel{144}}} = 20.$$

To find the contents of a true tapered pyramid, whether round, square or triangular.

RULE.—Multiply the area of the base by one third the height, and divide by 144.

EXAMPLE.—How many cubic feet in a round stick of timber, truly tapering to a point, 18 inches in diameter at the base, and twenty-four feet long? Ans. 14.1372 feet.

Process—$3.1416 \times 81 \times 8 \div 144 = 14.1372.$

2. How many cubic feet in a square block of

marble, truly tapering to a point, 24 inches on each side at the base, and twelve feet high.

$$\frac{24\times24\times4}{144}=16 \text{ feet, Ans.}$$

Gaugers' Work.

To find the contents of a cask in gallons.

RULE.—Add two-thirds the difference of the head and bung diameters to the head diameter, to find the mean diameter; then multiply the product of the square of the mean diameter into the length by .0034.

NOTE.—If the staves are but little curved, add six-tenths instead of two-thirds.

How many gallons in a cask, length 40 in., head diameter 21 in. and bung diameter 30 in.?

$\therefore 21+(\overline{30-21}\times\frac{2}{3})=27$ in. mean diameter.

$\therefore 27^2\times40\times.0034=99.144$ gallons.

Bricklayers' Work

Is sometimes measured by the perch, but more frequently by the 1000 bricks laid in the wall.

The following scale will give a fair average for estimating the quantity of brick required to build a given amount of wall:

$4\frac{1}{2}$ in. wall, per ft.,	superficial,		($\frac{1}{2}$ brick)	7	bricks.
9	"	"	(1 brick)	14	"
13	"	"	($1\frac{1}{2}$ brick)	21	"
18	"	"	(2 bricks)	28	"
22	"	"	($2\frac{1}{2}$ bricks)	35	"

NOTE.—For each half brick added to the thickness of the wall, add seven bricks.

A bricklayer's hod measuring 1 ft. 4 in. × 9 in. × 9 in., equals 1,296 inches in capacity, and will contain 20 bricks.

A load of mortar measures 1 cubic yard, or 27 cubic feet; requires 1 cubic yard of sand, and 9 bushels of lime, and will fill 30 hods.

Plasterers' Work

Is measured by the square yard, for all plain work: by the foot, superficial, for plain cornices; and by foot, lineal, for enriched or carved mouldings in cornices.

Painters' Work

Is computed by the superficial yard; every part is measured that is painted, and an allowance is added for difficult cornices, deep mouldings, carved surfaces, iron railings, etc. Charges are usually made for each coat of paint put on, at a certain price per yard per coat.

To find the height through which a body will fall, in feet, in a given time $\times$ the square of the time in seconds by 16.1

To find the velocity in feet per second acquired by a body in a given time, $\times$ the time in seconds by 33.2

The circumference of a circle multiplied by .2756 equals the side of an inscribed equilateral triangle.

The area of a circle multiplied by 1.2732 equals the square of the diameter.

The surface of a sphere equals the square of the radius multiplied by 12.5664.

The volume of a sphere equals the cube of the radius multiplied by 4.1888, or, the circumf'ce^3 $\times$ .0169

The square root of the surface of a sphere multiplied by 1.772454 equals the circumference.

The diameter of a sphere equals the cube root of its solidity multiplied by 1.2407.

The circumference of a sphere equals the cube root of its solidity multiplied by 3.8978.

The side of an inscribed cube equals the radius multiplied by 1.1547.

The solidity of a cone or pyramid equals the area of its base multiplied by one-third of its altitude.

The circumference of a circle equals the diameter multiplied by 3.1416, the ratio of the circumference to the diameter.

The area of a circle equals the square of the radius multiplied by 3.1416.

The area of a circle equals one quarter of the diameter multiplied by the circumference.

The radius of a circle equals the circumference multiplied by 0.159155.

The radius of a circle equals the square root of the area multiplied by 0.56419.

The diameter of a circle equals the circumference multiplied by 0.31831.

The diameter of a circle equals the square root of the area multipled by 1.12838.

The side of an inscribed equilateral triangle equals the diameter of the circle multiplied by 0.86.

The side of an inscribed square equals the diameter of a circle multiplied by 0.7071.

The side of an inscribed square equals the circumference of the circle multiplied by 0.225.

The circumference of a circle multiplied by 0.282 equals one side of a square of the same area.

The side of a square equals the diameter of a circle of the same area multiplied by 0.8862.

The area of a triangle equals the base multiplied by one-half its altitude.

The area of an ellipse equals the product of both diameters and .7854.

The solidity of a sphere equals its surface multiplied by one-sixth of its diameter.

The surface equals the product of the diameter and circumference.

The surface of a sphere equals the square of the diameter multiplied by 3.1416.

The surface equals the square of the circumference multiplied by 0.3183.

The solidity of a sphere equals the cube of the diameter multiplied by 0.5236.

The diameter of a sphere equals the square root of the surface multiplied by 0.56419.

SQUARE AND CUBE ROOT.

The first essential for the learner is to make himself familiar with the following properties of numbers:

1. A square number multiplied by a square number, the product will be a square number.

2. A square number divided by a square number, the quotient is a square.

3. A cube number multiplied by a cube, the product is a cube.

4. A cube number divided by a cube, the quotient will be a cube.

5. If the square root of a number is a composite number, the square itself may be divided into integer square factors; but if the root is a prime number, the square cannot be separated into square factors without fractions.

6. If the unit figure of a square number is 5, we may multiply by the square number 4, and we shall have another square, whose unit period will be ciphers.

7. If the unit figure of a cube is 5, we may multiply by the cube number 8, and produce another cube, whose unit period will be ciphers.

8. If a supposed cube, whose unit figure is 5, be multiplied by 8, and the product does not give 3 ciphers on the right, the number is not a cube.

TABLE

For comparing the natural numbers with the unit figure of their squares and cubes. By the use of this, many roots may be extracted by observation:

Numbers...	1	2	3	4	5	6	7	8	9	10
Squares....	1	4	9	16	25	36	49	64	81	100
Cubes......	1	8	27	64	125	216	343	512	729	1000

The product of a number taken any number of times as a factor, is called a power of the number.

A root of a number is such a number as taken some number of times as a factor, will produce a given number.

If the root is taken twice as a factor to produce the number, it is the *square root;* if three times, the *cube root;* if four times, the *fourth root.*

By observing the above table, it will be seen that the square of any one of the digits is less than 100, and the cube of any one of the digits is less than 1000; therefore, the square root of two figures cannot be more than one figure.

If we begin at the right of any number and separate it into periods of two figures each, the number of periods would be the same as the number of figures in its square root.

METHOD OF EXTRACTING CUBE ROOT.

By observing the *table*, we see that the entire part of the cube root of any number below 1000, will be less than 10, and will contain but 1 figure. The entire part of the cube root of a number containing four, five and six figures, will contain two figures, and so on with the larger numbers.

PROPORTION.

Proportion is the equality of ratios.

Ratio is the relation which one quantity bears to another of the same kind, with reference to the number of times that the less is contained in the greater.

Thus, the ratio of 7 to 21 is 3, because 7 is contained 3 times in 21, or 21 is 3 times seven. The same result is obtained if we divide 7 by 21, for we then find $\frac{7}{21} = \frac{1}{3}$, which means that 7 is $\frac{1}{3}$ of 21, and this expresses the very same relation as before, to say that 7 is $\frac{1}{3}$ of 21 is precisely the same as to say that 21 is 3 times 7. The ratio of 9 to 27 is 3, but we have seen that the ratio of 7 to 21 is also 3, therefore, the ratios of 7 to 21 and 9 to 27 are the same, $21 \div 7 = 27 \div 9$, and these quantities are thefore called proportionals.

In any proportion, as

$$7 : 21 :: 9 : 27$$

the product of the middle numbers, 21 and 9, equals the product of the extremes, 7 and 27; hence the *rule*, that when the fourth proportional is unknown,

Multiply the second and third terms, and divide the product by the first.

EXAMPLE.—If 7 sheep cost 21 dollars, what will 9 cost at the same rate? 27 dollars, Ans.

2d term,	21	
3d term,	9	Or thus, $\dfrac{\overset{3}{\cancel{21}} \times 9}{\cancel{7}} = 27$
1st term,	7)189	
	27	

Proportion is so much used in business, and may be simplified and shortened so much by the foregoing process of cancellation, that the pupil *must* learn both before he can hope to be expert with business calculations.

CANCELLING IN CALCULATION.—Whenever it is reqnired to multiply two or more numbers together, and divide by a third, the first step is to state the problem in its most manageable form; this can only be done by the use of the arithmetical signs.

The statement $\dfrac{28 \times 12}{14}$

is to be read, 28 multiplied by 12 is to be divided by 14.

Stating the problem as above we see at a glance if the divisor is contained, and how many times, in either of the multipliers.

In the foregoing example the divisor, 14, is contained twice in the multiplier, 28; then cancel the 14 and substitute 2 for the 28, and say, twice 12 is 24 the answer.

Process, $\dfrac{\overset{2}{\cancel{28}} \times 12}{\cancel{14}} = 24.$

EXAMPLE.—If 9 turkeys cost $18, what will be the cost of 27?

$$\frac{18 \times \overset{3}{\cancel{27}}}{\cancel{9}} = \$54\text{, Answer.}$$

If the divisor is not contained evenly in either of the multipliers, there may be a common divisor for the divisor itself and one of the multipliers; if so, the common divisor may be used in cancelling, thus:

$$\frac{\overset{7}{\cancel{63}} \times 8}{\underset{3}{\cancel{27}}} = 18\tfrac{2}{3}\text{, Ans.}$$

A glance shows that 9 is the common divisor for 63 and 27.

When a common divisor has been used to change the expression of the divisor and one of the multipliers, the new divisor may be cancelled when it is contained an even number of times in the other multiplier.

EXAMPLE—

$$\frac{\overset{7}{\cancel{63}} \times \overset{2}{\cancel{8}}}{\cancel{36} \quad \cancel{4}} = 14.$$

Process—36 and 63 divided by 9, the common divisor, becomes 4 and 7 respectively, the 4 into 8, 2 times, cancel 4 and 8, and twice 7 is 14, the answer.

When fractions are involved in the calculation, state each term in the form of fractions, taking care to *invert* the divisor.

EXAMPLE.—If 7 inches of velvet cloth cost $2\frac{1}{2}$ dollars, what will be the cost of 7 yards? $90, Ans.

Process, $$\frac{5}{\cancel{2}} \times \frac{\cancel{7}}{1} \times \frac{\overset{18}{\cancel{36}}}{\cancel{7}} = 90.$$

NOTE.—$2\frac{1}{2}$ dollars $= \frac{5}{2}$, 7 yards is $\frac{7}{1}$, 7 inches is $\frac{7}{36}$ of a yard, $\frac{7}{36}$ inverted is $\frac{36}{7}$.

Summary of the rapid process for *cancelling.*

1. Draw a horizontal line; above the line write dividends only; below the line write divisors only.

2. If there are ciphers above and below the line, erase an equal number on either side; 1 standing alone may be disregarded.

3. If the *same* number stands above and below the line, erase them *both.*

4. If any number on either side of the line will divide any number on the other side of the line without a remainder, divide, and erase the two numbers, retaining the quotient figure on the side of the larger number.

5. If any two numbers on either side have a common divisor, divide them by that number, and retain the quotients only.

6. Multiply all the numbers above the line for a dividend, and those below the line for a divisor; divide, and the quotient is the answer.

The foregoing process may be applied to compuing Interest.

RULE.—Place the *principal*, *rate %* and *number* of days for which interest is sought, above the line for dividends, then 36 below the line for a divisor.

EXAMPLE.—Find the interest on $350 for 40 days, at 9 % per annum?

$$\frac{350 \times \overset{10}{\cancel{40}} \times \cancel{9}}{\cancel{36}\quad \cancel{4}} \qquad \$3.500, \text{ Ans.}$$

Process—The 9 cancels the 36, leaving 4, this 4 cancels the remaining 40 above the line, leaving 350 × 10 for the answer.

Find the interest on $99 for 23 days, at 4 % per annum.

$$\frac{\overset{11}{\cancel{99}} \times 23 \times \cancel{4}}{\cancel{9}\quad \cancel{36}} \qquad \$.253, \text{ Ans.}$$

MARKING GOODS.

Removing the decimal point one place to the left on the cost of a dozen articles, gives the cost of one article with 20 per cent. added. We remove the point one place to the left, because 12 tens make 120. Hence, to find the selling price, to gain

the required percentage of profit, we have the following general rule:

RULE.—Remove the decimal point one place to the left on the cost per dozen, to gain 20 per cent.; increase or diminish to find the percentage, as per following table:

TABLE FOR MARKING ALL GOODS BOUGHT BY THE DOZEN.

To make 20% remove the point 1 place to left.

"	25%	"	"	"	"	Add	$\frac{1}{24}$	itself.
"	26%	"	"	"	"	"	$\frac{1}{20}$	"
"	28%	"	"	"	"	"	$\frac{1}{15}$	"
"	30%	"	"	"	"	"	$\frac{1}{12}$	"
"	32%	"	"	"	"	"	$\frac{1}{10}$	"
"	33⅓%	"	"	"	"	"	$\frac{1}{9}$	"
"	35%	"	"	"	"	"	$\frac{1}{8}$	"
"	37½%	"	"	"	"	"	$\frac{1}{7}$	"
"	40%	"	"	"	"	"	$\frac{1}{6}$	"
"	44%	"	"	"	"	"	$\frac{1}{5}$	"
"	50%	"	"	"	"	"	$\frac{1}{4}$	"
"	60%	"	"	"	"	"	$\frac{1}{3}$	"
"	80%	"	"	"	"	"	$\frac{1}{2}$	"
"	12½%	"	"	"	"	subtract	$\frac{1}{16}$	"
"	16⅔%	"	"	"	"	"	$\frac{1}{36}$	"
"	18¾%	"	"	"	"	"	$\frac{1}{96}$	"

If hats cost $20 per dozen, at what price are they to be sold to gain 20 per cent. profit? Ans. $2.00.

If hats cost $20 per dozen, at what price are they to be sold to gain 50 per cent. profit? Ans. $2.50.

CASTING OUT THE NINES.

The number nine has many peculiar properties in our system of notation. Any number is divisible by 9 when the sum of its digits is divisible by 9.

Any remainder left after dividing a number by 9, will be left after dividing the sum of its digits by 9.

This peculiarity may be used with advantage in proving the four fundamental rules, by casting out the nines, that is, dropping 9 whenever the sum reaches or exceeds that number, thus to cast the 9s out of 846732, we say 8+4 less 9 leaves 3; 3+6 less 9 leaves 0; 7+5 less 9 leaves 3; hence the following.

To prove ADDITION, cast out the nines from the example, and from the ascertained sum, if correct the excess in each will be the same.

To prove SUBTRACTION, the excess of the remainder should equal the excess in the minuend less the excess in the subtrahend.

NOTE. If the excess in the minuend is less than the excess in the subtrahend, it must be increased by nine.

To prove MULTIPLICATION. The excess of the product, must equal the product of the excess of the factors.

Note. If the multiplier or multiplicand is a multiple of nine, the product will have no excess.

To prove DIVISION. The excess of the dividend must equal the product of the excesses in Quotient and Divisor, plus the excess of the remainder.

Howard's New Rule

FOR COMPUTING INTEREST

On a basis of One Per Cent for all Rates.

Interest, in the various forms under which it accrues, has so large a place in every day business transactions, that a rapid and accurate method of computing *interest* is one of the most indispensable items of business knowledge.

The one that I present here, in all respects, is, without exception, the ***newest***, the ***easiest to learn***, and ***use***, the ***quickest*** and ***most correct*** in existence, adapted to ***all sums***, ***all periods***, and ***all rates per cent.***

Some of the reasons that suggested the construction of this rule will assist the learner in its acquirement. A child first conceives the idea of ONE thing, by and by, it is able to count SIX, but it is a long time before it apprehends that the six counted is six ONES.

THE UNIT—or one thing—is the idea of number in its simplest form, it is the basis of every number, the primary base of every fraction, the ***unit*** of ***six*** months is ***one*** month, the unit of a fraction is the reciprocal of the denominator, thus, $\frac{1}{8}$ is the ***unit*** of $\frac{5}{8}$; every step from the unit, increases the complexity of numbers, and consequently demands an increase of mental power and energy in dealing with them.

The most popular Interest rule is the "***six per cent***" method, by this rule, on removing the decimal point two places to the left, the interest on any sum is shewn for ***one-sixth*** of a year at ***six*** per cent. The interest on any sum is shown for ***one*** year at ***one*** per cent by the same act; the latter, which retains the ***unit*** of both denominations,—unchanged—must be the most natural and simple basis of calculation, and by consequence, the easiest to learn and use, hence the following :—

Rule,—Multiply .01 *of the principal by the given time and the product is the interest at one per cent.—Multiply the interest at one per cent by the given rate.*

NOTE 1,—Multiply by easy fractions of a year, or month, and the result will be uniformly correct, and requires less than half the mental labor demanded by other methods, a little practice, and careful study of the details of the following examples will enable the learner to select ***instantaneously*** the ***easiest*** multipliers,

NOTE 2.—To multiply by .1 remove the decimal point *one* place to the *left*; by .01 *two* places; by .001 *three* places.

What is the interest on £1000 for 11 yrs., 1 mo and 6 days at 1 per cent per annum?

			Yr.	Mo.	Da.	
£10.00	Int.	for	1	"	"	
100.00	"	"	10	"	"	first line $\times$10
1.00	"	"		1	6	" " $\times$.1
£111.00	"	"	11	1	6	

What is the interest on $846 for 1 yr. 7 mo., 12 da. at 1 per cent?

			Yr.	Mo.	Da.	
$8.46	Int.	for	1	"	"	
4.23	"	"	"	6	"	1st line $\times\frac{1}{2}$ because 6 mo. is $\frac{1}{2}$ a year.
.705	"	"	"	1	"	2d " $\times\frac{1}{6}$ " 1 " " $\frac{1}{6}$ of 6 mo.
.282	"	"	"	"	12	3d " $\times$.4 " 12 da " .4 of 1 mo.
13.677	"	"	1	7	12.	

What is the int. on $427.20 for 2 yr., 5 mo., 27 da. at 6 per cent?

			Yr.	Mo.	Da.					
$4.272	int.	for	1	"	"	at	1	per	cent.	
4.272	"	"	1	"	"	"	"	"	"	
1.424	"	"	"	4	"	"	"	"	"	1st line $\times\frac{1}{3}$
.356	"	"	"	1	"	"	"	"	"	3d " $\times\frac{1}{4}$
.3204	"	"	"	"	27	"	"	"	"	4th " $\times$.9
10.6444	"	"	2,	5,	27	"	1	"	"	
63.8664	"	"	"	"	"	"	6	"	"	R 37

What is the int. on £124.50 for 1 yr. 4 mo. 12 da. at 5 per cent per annum?

£1.245 int. for	1 yr.	mo.	da.	
.415	"	4	"	1st. line $\times\frac{1}{3}$
.0415	"	"	12	2d " $\times$.1
1.7015	1	4	12	
£8.5075 Int. at 5 per cent.				£192

NOTE. The interest is found on all sums at 1 per cent. a month by removing the decimal point to the left, 3 places for 3 days, and 2 places for 30 days.

Find the interest on £143 for 1 mo. 3 da. at 1 per cent per month.

£1.43 int. for 1 mo.
.143 " " 3 days 1st. line $\times$ .1
£1.573 Ans.

Find the int. on $216 for 7 mo. 18 da. at 2 per cent per month.

$2.16 int. for 1 mo. at 1 per cent.
15.12 " " 7 " " " " " 1st line $\times$ 7
1.296 " " 18 da. " " " " " " $\times$ .6
16.416
$32.832 Int. for 7 mo. 18 da. at 2 per cent. Ans.

Find the Int. on $846.50 for 5 mo. 19 da. at $1\frac{1}{4}$ per cent per month.

$8.465
42.325 1st line $\times$ 5
2.822 " " $\times\frac{1}{3}$ because 10 days is $\frac{1}{3}$ of a mo.
2.5395 " " $\times$ .3 " 9 " " .3 " "
47.6865
11.9216 previous line $\times\frac{1}{4}$
$59.6081 int. for 5 mo. 19 da. at $1\frac{1}{4}$ per cent Ans.

Find the Int. on £715 for 8 mo. 11 da. at .9 of 1 per cent month.

£7.15 Int. for 1 mo.
57.20 " " 8 "
1,43 " " 6 da. $=\frac{1}{5}$ of 1 month.
1.192 " " 5 " $=\frac{1}{6}$ " " "
59.822
£53.8398 int. for 8 mo. 11 da. at .9 of 1 per cent.

Legal Interest

is computed on the basis of 365 days to the year.

The LEGAL INTEREST on £1, or $1, for 1 day, at 1 per cent per annum, is .0000274, hence the following

Rule.—Annex 0 *to the number of days, multiply by* 274 *reversed, then annex* 0 *to the number of pounds, or dollars, multiply by the figures in the first product, reversed, remove the point four places to the left, and the interest for the given time, and principal, is shewn at* 1 *per cent per annum. Multiply this by the given rate.*

Find the LEGAL interest on £233 Stg. for 232 days at 7 per cent per annum.

```
     £2330                        2320
      6536                         472
    ------                        ----
     13980                        4640
       699                        1624
       116                          92
        14                        ----
    ------                        6356
    1.4809  int. at 1 per cent.
         7                          £  s.  d.
   -------
   10.3663  int. at 7 per cent.  Ans. 10 : 7 : 4
```

Find the LEGAL interest on £333,, 7,, 6 for 77 days at 1 per cent per annum.

```
     £333.375                      770
      112                          472
     -----                        ----
      6668                        1540
       333                         539
        33                          31
     -----                        ----
     .7034                        2110
```

Ans. 14 shillings and 3 farthings.

Find the interest on £719,,17,,9, for 2 yrs. 7 days, at 1 per cent

£719.887	070
291 02	472
1439 77	140
7 10	49
6 47	3
14	20192
14.5358	

Note.—When the time is in years and days, to the product of the days by 472, prefix for 1 yr. 10, for 2 yrs. 20 &c., and use two decimals in the princpal.

Ans. £14,,10,,8½.

Howard's New Rule

For Computing Interest by dividing the year, or month, by the rate, may be used in all cases when the figure. or figures, representing the rate, is the aliquot part of a year, or month, under this rule the interest can be found in the twinkling of an eye, on a million examples, for three periods of time, without altering one figure of the principal.

Rule.—Divide the year, or month, by the rate, and the Quotient is the time in which £1 stg., or $1, earns .01 *part of itself, to find the interest for the quotient, remove the decimal point two places, for* .1 *that time, three places, and for ten times the quotient, one place to the left.*

Find the interest on $714.50 for 400 days at 9 per cent per annum. Ans. $71.45.

Explanation, 360 ÷ 9 = 40, in 40 days the dollar earns a cent, the interest is found for 40 days at 9 per cent, by removing the point *two* places to the left, for 10 times 40 days, by removing the point *one* place.

Find the interest on $125 for 10 days at 3 per cent per month. Ans. $1.25.

Explanation 30 days ÷ 3 = 10 days, in ten days, one dollar earns *one* cent, at 3 per ceut per month;

1 cent is the $\frac{1}{100}$ part of a dollar; the interest for that time will be found by simply removing the decimal point two places to the left, because removing the point two places to the left divides by 100.

Howard's new Rule for computing interest by cancellation:—

RULE.—1st. Draw a line thus |

2d. On the right of the line put the principal and the time in days.

3d. On the left the number of days—or its factors—in which a dollar earns a cent. at the given rate.

4th. Having stated the problem, proceed as directed at page 60. The answer will be in cents.

EXAMPLE.—What is the interest on 420 dollars for 40 days at 9 per cent. per annum?

$$\begin{array}{r|l} & 4.20 \\ \cancel{40} & \cancel{40} \end{array} \qquad \text{Ans. \$4.20.}$$

What is the interest on 99 pounds sterling at 4 per cent. for 27 days?

$$\begin{array}{r|l} \cancel{9} & \cancel{99}\ 11 \\ & .297 \end{array} \qquad \text{Ans. } 5s.\ 11\tfrac{1}{2}d$$

When the interest required is for any given number of days, it is usual to divide by 365, which in practice is found to be very cumbrous. I have directed my researches to substitute a simpler divisor, with the following result:—To multiply by $1\frac{3}{20}$ and divide by 42 is in effect the same as to divide 10 by 365, in practice is very much simpler and shorter, the actual difference to each unit of value being only the difference of $\frac{1680}{61320}$ and $\frac{1679}{61320}$ or $\frac{1}{61320}$, too trifling to affect any business transaction.

To multiply by $1\frac{3}{20}$ add $\frac{1}{10}$ and half of $\frac{1}{10}$ of any number to itself.

Example: Multiply 100 by $1\frac{3}{20}$.

$$
\begin{array}{r}
100 \\
10 \\
5 \\
\hline
115
\end{array}
$$

To compute interest for any number of days, 365 days to the year:

RULE.—Multiply the principal by $1\frac{3}{20}$, remove the point *three* places to the left, and the interest will be shown for the following number of days, and rates, to find the interest for any other time or rate, increase or diminish:—

42	days at	1	per cent.	7	days at	6	per cent.
21	"	2	"	6	"	7	"
14	"	3	"	4	"	10½	"
12	"	3½	"	3	"	14	"
10½	"	4	"	2	"	21	"

Remove the point *two* places to the left, and the interest will be shown for

84	days at	5	per cent.	35	days at	12	per cent.
56	"	7½	"	28	"	15	"
42	"	10	"				

DISCOUNT.

Discount, being of the same nature as interest, is, strictly speaking, the use of money before it is due. The term is also applied to a deduction of so much per cent. from the face of a bill, or the deducting of interest from the face of a note before any interest has accrued. Banks generally include

in their reckoning both the day when the note is discounted and the day on which the time specified in it expires, which, with three days of grace, makes the time for which discount is taken four days more than the time specified in the note. *True Discount* differs from *Bank Discount*, that is, the true discount on a debt of 109 dollars due a year hence would be 9 dollars, the legal interest being at the rate of 9 per cent., and the present worth of the note is 100 dollars.

In calculating interest the sum on which interest is to be paid is known, but in computing discount we have to find what sum must be placed at interest, so that the sum, together with its interest, will amount to the given principal; the sum thus found is called the "Present worth."

To find the present worth of any sum, and the discount for any time at any rate per cent.

Rule.—Divide the given sum by the amount of $1 for the given time and rate, and the quotient will be the present worth, and the remainder will be the discount.

Example 1.—Find the present worth of a note for 228 dollars, due 2 years from date at 7 per cent.

Ans. $200.

2. Find the bank discount on a note for £1200, due 60 days from date.

$60 + 4 = 64$ days time for which discount must be reckoned. $\frac{1}{6}$ of $64 = 10\frac{2}{3} \times 1200 = 12.800$.

Ans. 12.80.

Merchants are in the habit of deducting a certain percentage from invoices of goods sold. This is reckoned in the same manner as interest.

A bill of goods is bought, amounting to 960 dollars at a year's credit, the merchant offers to deduct 10% for ready cash, what amount is to be deducted?

$$9.60 \times 10 = \$96.00, \text{ Ans.}$$

By discounting the face of bills, a loss may be sustained without suspecting it; this arises from the fact that the discount is not only made on the first cost of the goods, but also on the profits; for instance, if a profit of 30% be made on any article of merchandise, and the 10% be deducted, the gain at first sight would appear to be 20%, but is in reality only 17%. If a profit of 60% be added to the first cost, and then a discount made of 45%, the apparent profit would be 15%; instead of this, an actual loss is made of 12%, as will be seen by the following examples:

Example 1.		Example 2.	
Cost of goods,	$100	Cost,	$100
Add 30% profit,	30	Profit 60%,	60
Selling price,	130	Selling price,	160
Deduct 10% discount,	13	Discount 45%,	72
Cash price,	$117	Cash price,	$88
Gain 17%.		Loss 12%.	

The net amt. of a bill, less 10 per cent discount, will be shewn by multiplying by 9, and removing the decimal point one place to the left. Example. £100×9=£90.0

To find the net. amt. less discount at

5 per cent ×9½.	30 per cent ×7.	50 per cent ×5.
15 " " ×8½.	35 " " ×6½.	55 " " ×4½.
20 " " ×8.	40 " " ×6.	60 " " ×4.
25 " " ×7½	45 " " ×5½.	70 " " ×3.

and remove the point 1 place to the left.

EXCHANGE.

EXCHANGE is the giving or receiving of any sum in one kind of money for its value in another.

EXAMPLE 1. Find the value of gold, the price of greenbacks being 75 cents Ans. 133⅓.

Process— $\frac{100}{75}=\frac{4}{3}=1.33\frac{1}{3}$

2. Find the value of currency, the price of gold being 133⅓. Ans. 75 cents.

Process— $\frac{100}{133\frac{1}{3}}=\frac{3}{4}=.75$

$500 in gold at 8 per cent. premium will buy how much currency?

$500×1.08=$540

$500 in currency will buy how much gold at 8 per cent premium?

500÷108=$462.96.

$1000 in gold is worth how much currency at 80 cents?

$1000÷.80=1250.

What is the face value of a bill of Exchange costing £1000. Commission $\frac{3}{4}$ per cent?

£1000÷1.0075=£992.55

What is the cost of a bill of Exchange for $1000 Premium $\frac{3}{4}$ per cent.

$1000×1.00$\frac{3}{4}$=$1007.50.

Find the par value of £473 ,, 5 ,, 9 St'g. in American gold coin.

£473.2875×4.8665=$2303.25.

	473.2875
Note. To avoid encumbering the operation with	56.684
valueless decimals, reverse the multiplier, and begin	1893.150
each line of the partial products with the product of	378.630
the multiplying figure and the figure directly above	28.397
it, adding what otherwise would have been carried.	2.839
The par value of £1 st'g is fixed by act of Con-	.237
gress 1873, at $4.8665.	2303.254

BRITISH MONEY.

Howard's new rules for INTEREST, EQUATION OF PAYMENTS, &c., may be used with equal facility in dealing with British and other foreign money.

The British people would simplify all their monetary operations, and save millions every year in labor alone, by adopting the decimal system of coinage. The cost and temporary inconvenience incident to the change would be trifling, almost *nil*, in view of the advantage to be gained. The pound, the florin, the shilling and the sixpence might be retained. Make the smallest coin, the farthing, equal to the $\frac{1}{1000}$ of a pound, and the thing is done.

NOTE.—By carefully observing and practicing the following instructions, the converting of shillings, pence and farthings into decimals of a pound, and *vice versa*, will become a purely mental and instantaneous operation.

1. For every two shillings, or florin, write .1, because two shillings is $\frac{1}{10}$ of a pound stg.

2. For every 1 shilling, write .05, because one shilling is $\frac{5}{10}$ of a florin, or $\frac{5}{100}$ of a pound stg.

3. For every six-pence, write .025, because six-pence is $\frac{25}{100}$ of a florin, or $\frac{25}{1000}$ of a pound stg.

4. For every $2\frac{1}{2}$ pence, write .01, because $2\frac{1}{2}$ pence is $\frac{1}{100}$ of a pound stg.

5. For every farthing, write .001, because a farthing is $\frac{1}{1000}$ of a pound stg.

£19,,2	written decimally	becomes	19.1
19,,3	"	"	19.15
19,,4	"	"	19.2
19,,5	"	"	19.25
19,,18	"	"	19.9
19,,19	"	"	19.95
19,,19,,$2\frac{1}{2}$	"	"	19.96
19,,19,,5	"	"	19.97
27,,12,,6	"	"	27.625
19,,19,,$5\frac{1}{4}$	"	"	19.971
19,,18,,$0\frac{3}{4}$	"	"	19.903
19,,16,,$1\frac{3}{4}$	"	"	19.807
24,, 1,,$1\frac{1}{2}$	"	"	24.056

The learner may extend the exercises indefinitely the *essentials* to remember are—

1st. Each unit of the first figure to the right of the decimal stands for *two* shillings.

2d. Each 5 in the second figure to the right of the decimal, stands for *one* shilling.

3d. Each unit *above* or *below* 5 in the second figure, stands for $2\frac{1}{2}$ pence.

4th. Each unit of the third figure to the right of the decimal, stands for 1 farthing.

—5th. In stating a problem, add 1 to the third decimal. for the sixpence, —if any— in the example.

NOTE.—The *exact* value of each unit in the second figure to the right of the decimal is $2\frac{4}{10}$ of a penny, and of each unit in the third figure to the right of the decimal, $\frac{24}{100}$ of a penny, the difference of the assumed and the real value is too trifling to affect any actual business operation. The *florins*, *shillings* and *sixpences* are decimally expressed *absolutely* correct.

EXERCISES IN PERCENTAGE.

The following examples embrace most of the conditions under which *percentage* occurs in business, and the mode of solution in each case applies to all similar examples.

How many of 500 sheep will be left, if 20 per cent. of them are sold?

$500\times.20=100.$ $500-100=400$ *sheep.*

What per cent of 300 is 75? $75\div300=25$ ℔ ct.

Of what number is 48, 8 ℔ ct.? $48\div.08=600.$

Sold a horse for £60, made 25 ℔ ct., what did it cost? $1+.25=1\frac{25}{100}=\frac{5}{4}$ $5 \mid \frac{4}{60}=£48$

Sold a horse for \$40, lost 20 ℔ ct. What did it cost?

$1-.20=\frac{80}{100}=\frac{8}{10}$ $\quad 8 \mid \frac{10}{40}=50$ *dollars.*

The population of a village increased from 900 to 1200, at what rate per cent. did it increase ?

$1200\div900=1.33\frac{1}{3}-1=33\frac{1}{3}$ *per cent.*

The sales of a firm fell off from £12000 to £9000, what was the rate per cent of decline?

$9000\div12000=.75.$ $1-.75=25$ *per cent.*

Bought a horse for \$80, sold it for \$105. What per cent profit?

$105\div80=1.31\frac{1}{4}-1=31\frac{1}{4}$ *per cent.*

Bought a piano for \$300, sold it for \$250. What per cent. loss?

$300-250 \div 300 = .16\frac{2}{3}$ *per cent.*

Bought a horse for \$40. What must it be sold for to gain 20 per cent?

$40\times.20=8+40=48$ *dollars.*

A horse was sold for \$24; the rate per cent profit was the same as the number of dollars it cost. What was the cost, and what the gain per cent?

Cost \$20. $20^2=400\times.01=4.$ *Profit* \$4, *or*

$\sqrt{}$ *of the profit is* .1 *the cost.* $\sqrt{}$ *of* $4=2\times10=20$
Cost \$20. *Profit* 20 *per cent.*

How many dollars will earn 1 cent a day at 9 per cent per annum?

$360\div9=40.$ *Ans.* \$40.

How many dollars will earn 1 cent a day at $1\frac{1}{4}$ per cent per month?

$30\div1\frac{1}{4}=24.$ *Ans.* \$24.

Stocks and bonds are quoted in New York by so much on the hundred, premium or discount; in Philadelphia at their actual price. That is, if the par value of a stock is $50, and it is 6% above par, the New York quotation would be 106, the Philadelphia quotation 53.

When the premium is known, the par value plus the premium equals the market value. When at a discount, the par value minus the discount equals the market value.

To find to what rate of interest a given dividend corresponds.

RULE.—Divide the rate per unit of dividend by 1 plus or minus the rate per cent., premium or discount, according as the stocks are above or below par.

What per cent will be gained by investing in 8 *per cent stock, at* 20 *per cent premium?*

120 | 800=$6\frac{2}{3}$ *per cent.*

What per cent will be gained by investing in 6 *per cent stock at* 10 *per cent discount.*

100−10=90. 90 | 600=$6\frac{2}{3}$ *per cent.*

To find at what price stock paying a given rate per cent. dividend can be purchased, so that the money invested shall produce a given rate of interest.

RULE.—Divide the rate per unit of dividend by the rate per unit of interest.

What must be paid for stock paying 6 *per cent dividend, in order to realize on the investment* 8 *per cent?*

8 | 600=75.

COMPOUND INTEREST.

The rule for calculating compound interest, is to add the interest to the principal, and calculate the interest on the sum. The use of the following table will shorten this tedious process. It gives the amount for one dollar at 5, 6 and 7 per cent. for from 1 to 20 years. Multiply the amount for $1 by the given number of dollars, and the product is the answer.

YEARS.	5 PER CENT.	6 PER CENT.	7 PER CENT.
1	1.050000	1.060000	1.070000
2	1.102500	1.123600	1.144900
3	1.157625	1.191016	1.225043
4	1.215506	1.262477	1.310796
5	1.276282	1.338226	1.402552
6	1.340096	1.418519	1.500730
7	1.407100	1.503630	1.605781
8	1.477455	1.593848	1.718186
9	1.551328	1.689479	1.838459
10	1.628895	1.790848	1.967151
11	1.710339	1.898299	2.104852
12	1.795856	2.012196	2.252192
13	1.885649	2.132928	2.409845
14	1.979932	2.260904	2.578534
15	2.078928	2.396558	2.759032
16	2.182875	2.540352	2.952164
17	2.292018	2.692773	3.158815
18	2.406619	2.854339	3.379932
19	2.526950	3.025600	3.616526
20	2.653298	3.207135	3.869684

NOTE.—The above table is available for British money by reading pounds and decimals of a pound, for dollars and decimals of dollars.

To find the time in which any sum will double itself at compound interest, at any rate not exceeding 10% per annum.

RULE.—Divide 70 by the rate of interest, and take the whole number nearest the quotient. This is the number of years.

Rate.		Years.
3	$\frac{70}{3} =$	23
4	$\frac{70}{4} =$	17
5	$\frac{70}{5} =$	14
6	$\frac{70}{6} =$	12
7	$\frac{70}{7} =$	10
8	$\frac{70}{8} =$	9
9	$\frac{70}{9} =$	8
10	$\frac{70}{10} =$	7

Legal Interest is reckoned on the basis of 365 days to the year, when this is required, and the calculation is made on the basis of 360 days, subtract $\frac{1}{73}$ for the common year, or $\frac{1}{61}$ for a leap year, and the legal interest will be shewn.

To prove interest, divide the computed interest by the interest for one day, and the quotient should be the number of days in the example, or divide by the interest for one month and the quotient should be the number of months.

HOWARD'S.
GOLDEN RULE.
FOR
EQUATION OF PAYMENTS,

AVERAGING ACCOUNTS and PARTIAL PAYMENTS, is so called, not only because it is absolutely correct, and consequently equally just to both Debtor and Creditor, but also because it is exceedingly simple, and easy to learn and use.

The methods hitherto in use are *intricate*, *tedious*, and *perplexing*, and more or less *inaccurate:* the PRODUCT methods requiring, with each item, the finding the number of days between two dates, and the use of difficult multipliers.

The INTEREST methods introduce a *superfluous* element, and needlessly increase the complexity of the operation. Interest, really has nothing to do with finding when a balance is due.

The object sought is a *certain date*, HOWARD'S GOLDEN RULE seeks and finds this—*and this only*—directly, accurately and easily. By its use the CASH BALANCE of the most complex Dr. and Cr. accounts may be easily found, without reference to interest, except where it properly belongs; viz,—on the balance.

The novel and special excellence of this rule consists in multiplying by months,and easy fractions of a month, and also in the *simple* and *natural* arrangement of the parts of the problem, the dates themselves representing the multipliers.

Experienced Accountants say, "it very much lessens the *drudgery* of the counting house."

EQUATION OF PAYMENTS is the process of finding the EQUATED TIME, or the date when the sum of several debts due at different times may be paid and includes,—

Bills bought on *unequal* time on the *same* date.
Bills bought on *equal* time on *different* dates.
Bills bought on *unequal* time on *different* dates, and MONTHLY STATEMENTS.

AVERAGING ACCOUNTS is the process of finding the date on which the BALANCE is due, and applies to all Dr. and Cr. accounts.

PARTIAL PAYMENTS are parts of a debt paid at different times; usually written on the back of notes and other interest bearing obligations, and called indorsements. The term also includes payments made on account of a debt before it is due.

TERM OF CREDIT is the time to elapse before a bill becomes due.

The AVERAGE TERM of credit is the time at the end of which the sum of several debts due at different dates may be paid at once.

EQUATED TERM is the average time for which interest is due on an account, or balance, and is always reckoned from the zero date.

Interest is reckoned on accounts, and balances from the date on which they are due.

AN ACCOUNT is a statement of business transactions between Debtor and Creditor.

A BALANCE is the difference of two sides of an account.

A CASH BALANCE is the same, with the interest due.

THE ZERO DATE is the date,—or starting point,—from which all the other dates are reckoned, in this rule it is always the beginning—or starting point—of the month in which the first debt in the acct. occurs.

BILLS BOUGHT ON UNEQUAL TIME ON THE SAME DATE.

1878, Jan. 1st,	Bought goods on 8 mos.	£100
" " "	" " " 6 "	100
" " "	" " " 7 "	100

On what date may the whole £300 be paid?

Term of Cr Mo..	Date.	
8	Jan. 1.	100×8=800
6	" "	100×6=600
7	" "	100×7=700
		300)2100(7 mo. fr. Jan. 1, or Aug. 1.

Under the terms of this transaction the Debtor is entitled to the use of

1st, £100 for 8 months, =8 times 100 or £800 for 1 mo.
2d, 100 " 6 " =6 " 100 " 600 " 1 "
3d. 100 " 7 " =7 " 100 " 700 " 1 "

a credit equal to £2100 for 1 month; this will evidently entitle the debtor to the use of £300 for as many months as 300 is contained in 2100.

The *product* of any number of *pounds* multiplied by any number of months, and fractions of a month, a Debtor is entitled to use them, is the number of pounds he is entitled to use for 1 month under the same terms, hence the following:—

Rule.—Multiply each debt by its term of credit, divide the sum of the products by the sum of the debts, and the quotient is the equated term.

First study this very simple example thoroughly, make yourself familiar with each operation, the reason for its use, and the causes of the results, and you will then have no difficulty in comprehending the most complex Debtor and Creditor accounts.

BILLS BOUGHT ON EQUAL TIME AT DIFFERENT DATES.

Required the equated time of paying the following bills each bought on 8 months credit.

No of months, from zero date	1878				
	June	0—Zero date.			
	June	9	£180 × .3 =		54
1	July	15	84 × $1\frac{1}{2}$ =		84 42
3	Sept.	14	240 × 3.$3\frac{1}{6}$ =		720 72 40
4	Oct.	10	96 × $4\frac{1}{3}$ =		384 32
			£600		)1428(2.38
					3
					11.4

	mo. da.		yr. mo. da.	
Equated term	2, 11	after	78, 6, 0	zero date.
Plus term of Cr.	8, 0	=	10, 11,	
Equated time			79, 4, 11,	or April 11th, 1879.

Rule,—Multiply each debt by the time—in months and fractions of a month,— between its occurrence and the zero date, divide the sum of the products, by the sum of the debts, and the quotient is the equated term— in months and hundredths of a month,— counting from the zero date, add the term of credit, and the sum is the equated time.

NOTE 1. To reduce hundredths of months to days, multiply by 3, and point off the right hand figure, when the right hand figure in the product is 5 or more add 1 day, otherwise disregard it.

NOTE 2, When the figures representing the day of the month are multiples of 3, such as the 3d, 9th, 27th, &c. &c., multiply by tenths, because 3 days is .1 of a month; when they are not multiples of 3 then multiply by the simplest fraction, or fractions of a month. In the above example, Sept. 14th,. 3 months 14 days from zero date, we multiply by 3.3$\frac{1}{6}$, 3 months, plus 9 days, plus 5 days. Facility in selecting the simplest fractions for multipliers is easily acquired by practice.

BILLS BOUGHT ON UNEQUAL TIME AT DIFFERENT DATES.

Required the equated time of paying the following bills of goods.

Term of Cr. Mos.	April	0			
6	"	10	To Mdse.	£310×$6\frac{1}{3}$ =	1860 103
2	1 May	21	" "	468×3.7 =	1404 328
4	2 June	1	" "	520×$6\frac{1}{30}$ =	3120 17
3	3 July	8	" "	750×$6.1\frac{1}{6}$=	4500 75 125
				2048	)11532(5.63

	Mo.	Da.	
Zero date	4	0	
Equated term	5	19	3
Equated time	9	19 or Sept. 19th.	18.9

Rule—Multiply each debt by the term of credit, plus the time between the date of the transaction and the zero date; divide the sum of the products by the sum of the debts, and the quotient is the equated term.

The figures on the extreme left represent the terms of credit; the figures on the left of the month represent the number of months from the zero date, these together with the day of the month are the multipliers.

	mos.			mos. da.					
1st item	6	Cr.	plus	0, 10	from	0	date	=$6\frac{1}{3}$	mos.
2d "	2	"	"	1, 21	"	"	"	=3.7	"
3d "	4	"	"	2, 1	"	"	"	=$6\frac{1}{30}$	"
4th "	3	"	"	3, 8	"	"	"	=$6.1\frac{1}{6}$	"

NOTE.—The use of the beginning of the month, instead of the date of the first transaction for the starting point, makes no difference in the ultimate result, and avoids the continual labor of finding on each item, the time between two dates, each date as written, *itself* representing the time.

MONTHLY STATEMENTS.

Find the equated time for paying the following acct'
1878

Jan.	1	To Goods	$660.00 × $\frac{1}{30}$ =	22
	3	" "	841. " × .1 =	84
	4	" "	730. " × .1 $\frac{1}{30}$ =	{ 73 24
	5	" "	786. " × $\frac{1}{6}$ =	131
	6	" "	815. " × $\frac{1}{5}$ =	163
	8	" "	612. " × .1 $\frac{1}{6}$ =	{ 61 102
	10	" "	312. " × $\frac{1}{3}$ =	104
	11	" "	215.25 × $\frac{1}{5}$ $\frac{1}{6}$ =	{ 43 36
	15	" "	118. " × $\frac{1}{2}$ =	59
	16	" "	30. " × $\frac{1}{3}$ $\frac{1}{5}$ =	{ 10 6
	19	" "	86. " × .3 $\frac{1}{3}$ =	{ 26 29
	20	" "	66. " × $\frac{2}{3}$ =	44
	23	" "	48. " × .6 $\frac{1}{6}$ =	{ 29 8
	27	" "	100. " × .9 =	90
	28	" "	27. " × .6 $\frac{1}{3}$ =	{ 16 9
	30	" "	48.75 × 1 =	49
			5495.	)1218(.22 3 6.6

Equated time Jan 7th.

Rule,—Multiply each debt by the time between its occurrence and the zero date, divide the sum of the products by the sum of the debts, and the quotient is the equated term

This example is extended for the purpose of introducing every possible fraction of a month, the selection of the simplest fractions for multipliers will become the work of an instant by practice.

Note.—Omit the cents when under fifty, add one dollar when they are fifty or more.

Find the equated time of paying the balance of the following accts

1878		Dr.			1878		Cr.		
Mar.	0				Mar	0			
"	15	3 mos.	$600 \times 3\frac{1}{2} =$	1800 300	2 May	10	By Cash	$300 \times 2\frac{1}{3} =$	600 100
1 Apr.	3	4 "	$700 \times 5.1 =$	3500 70	4 July	1	" "	$400 \times 4\frac{1}{30} =$	1600 13
2 May	10	6 "	$1000 \times 8\frac{1}{3} =$	8000 333	5 Aug	15	" "	$500 \times 5\frac{1}{2} =$	2500 250
			2300	14003				1200	5063
			1200	5063					
			1100	)8940(8.13					

3

3.9

Balance due Nov. 4th, 8 mos. 4 days after zero date.

1877		Cr.			1877		Dr.		
June	0				June	0			
1 July	4	By Note	$158 \times 1.1\frac{1}{30} =$	158 16 5	"	20	To Goods	$986 \times \frac{2}{3} =$	329 329
5 Dec.	18	" Md'e	$228 \times 6.6 =$	1368 137	5 Nov.	16	" "	$152 \times 5\frac{1}{3}\frac{1}{5} =$	760 51 30
1878					1878				
9 Mar	5	" "	$450 \times 9\frac{1}{6} =$	4050 75	8 Feb.	26	" "	$110 \times 8.7\frac{1}{6} =$	880 77 18
			836	5809				1248	2474
				2474				836	
				412)3335(8.09				412	

3

2.7 8 mo. 3da before zero date.

Zero date	77,	6,	0
Minus		8,	3
	76,	9,	27

Balance due Sept. 27th, 1876.

In this example the balance of the products is on the smaller side of the account; when this happens the eqated term is deducted from the zero date to find the equated time.

The credit side has the ADVANTAGE of the use of the equivalent of £3335 for one month, then the other side is entitled to interest on the balance for as many months as 412 is contained in 3335.

Rule.—Multiply each item by the time between its occurrence and the zero date, added to the term of credit—if any— divide the balance of the products by the balance of the account and the quotient is the equated term.

Note,—This rule applies to Partial Payments and all Dr. and Cr. accounts.

R 114 E 241

A note is made March 15th, 1878 for €720.
Endorsed April 3d, pd. on account £170
" May 20th, " " " 245
' June 18th " " " 87
from what date must interest be computed on the balance.

Apr,	3	$170\times1.1=$	170	Mar.	15	$720\times\frac{1}{2}=360$
			17			502
2 May	20	$245\times2\frac{2}{3}=$	490			
			164			218
3 Ju.	17	$87\times3.4\frac{1}{6}=$	261			
			35			
			14			
		502	1151			
			360			

218)791(3.62 3mos. 19 da. before 0 date.

Zero date	78,	3,	0
Minus		3,	19
Equated time	7,	11,	11

Nov. 11th, 1877.

PAYM'TS MADE ON ACC'T OF A DEBT BEFORE IT IS DUE

1878	Cr.		1878	Dr.
March 1	By Cash	$300	Jan. 1st, to goods on 6 mos.	$1500
May 1	" "	400		

On what date is the balance $800 due.

Jan	1	$1500\times6=9000$	2 March	1	$300\times2=$	600
		2200	4 May	1	$400\times4=$	1600
		800)6800			700	2200
		$8\frac{1}{2}$				

Ans. $8\frac{1}{2}$ mos. after Jan. 1st, Sept. 15th.

Explanation,—under the terms of this transaction the debtor is entitled to the use of $1500 for 6 months, equal to 6 times 1500 or $9000 for 1 month on paying

$300 in 2 mos. the use of which for that time is=$600 for 1 mo.
400 " 4 " " " " " " " " "= 1600 " 1 "

he has used the equivalent of $2200 for 1 month and is consequently entitled to the use of the balance for a time equal to the use of $6800 for one month.

T. 269 R. 107

The Creditor is entitled to interest on the Balance from the date on which it is due, to the date of settlement. The Debtor is entitled to discount off the Balance for the time he pays it before it is due.

Find the Cash Balance on each of the four preceding acc'ts.

1st,—£1100 due Nov. 4th, settled Aug. 22d, int. at 6 per cent.

	mo. da.			
Balance due	11, 4	Am't of £1		Cash Balance
Date of settlement,	8, 22	mo. da.	1.012	1100=£1086.95. Ans.
Difference,	2, 12	for 2 12		

2d,—£412 due 27 \| 9 \| 76, date of settlement 27 \| 7 \| 78. Interest 6 per cent

Yr.	Mo.	Da.	
78	7	27	
76	9	27	Yr. Mo.
1	10		Int. for 1, 10, 45.32+ 412=£457.32. Ans.

3d,—£218 due 11 \| 11 \| 77, date of settlement 5 \| 9 \| 78 Interest 6 per cent

78	9	5	
77	11	11	Mo. Da.
	9	24	Int. for 9 24, 10.68+ 218=£228-68. Ans.

4th,—$800 due 78 \| 9 \| 15 \| date of settlement 78 \| 12 \| 19 Int. 7 per ct

Mo.	Da.	
12	19	
9	15	Mo. Da.
3	4	Int. for 3, 4, 14.62+$800=$814.62. Ans.

TO FIND THE DIFFERENCE OF TIME BETWEEN TWO DATES.

Rule. Subtract the earlier from the latter date.

Example.—For what time must interest be charged on a debt due the first of May, 1873, and settled on the ninth of March, 1875.

Process, 75 : 3 : 9
73 : 5 : 1
1 : 10 : 8 Ans. 1 yr. 10 mo. 8 days.

Mehtode zu sagen den Tag auf die Woche nach jedem Datum von Christi Geburt dreitausend Jahr.

Methode.—Streich die Sieben aus von die beiden letzten Nummern auf das Jahr, der Minuent von den beiden letzten Nummern im Jahre, dividirt bei vier—gebrauche nicht den Rest—den Datum auf den Monat, und die Figur auf das Jahr. Was überbleibt ist der Tag in der Woche, der erste Sonntag, der zweite Montag u. s. w.

Die Figuren vor die Monate.

1 vor Sept. u. Decbr.	8 vor Jan. u. Oct.	5 vor August.	0 vor Junt.
2 vor April und Jult.	4 vor Mat.	6 vor Feb., März, Nov.	

Der Datum im Januar und Februar ist ein weniger im Schaltjahr.

Datum auf die Jahre.

1, ist die Figur vor das 2te, 9te und 16te Jahrhundert.
2, " " " " " 1te, 8te, 15te, 18te, 22te, 26te und 30te Jahrhundert.
3, " " " " " 8te, 7te, 14te Jahrhundert.
4, " " " " " 6te, 13te, 17te, 21te, 25te, 29te Jahrhundert.
5, " " " " " 5te, 12te, 20te, 24te, und 28te Jahrhundert.
6, " " " " " 4tc nnd 11 Jahrhundert.
0, " " " " " 3te, 10te, 19te, 23te und 27te Jahrhundert.

Exempel.—Welcher Tag in der Woche war der 31. August, 1873? Antwort, Sonntag.

Die letzten beiden Figuren im Jahre,	73 — 70 = 3
Minuent auf do. ÷ bei vier,	18 + 3 — 21 = 0
Datum im Monat,	31 — 28 = 3
Figur auf den Monat,	5 + 3 — 7 = 1

Der Rest 1 zeigt Euch den ersten Tag in der Woche, welcher ist Sonntag.

Howard's California Calendar for Thirty Centuries.

RULE.—Cast the sevens out of the last two figures of the year, the quotient of the two last figures of the year divided by four—disregarding the remainder, if any—the day of the month, the figure for the month, and the figure for the century. One remainder will be the first day of the week; 2, second; 0, last day of the week.

TABLE OF FIGURES FOR THE MONTHS.

1, Sept. and Dec.	3, Jan. and Oct.	5, August.	0, June.
2, April and July.	4, May.	6, Feb., March, Nov.	

NOTE.—The figure for January is 2, and February 5 in leap year.

TABLE OF FIGURES FOR THE CENTURIES.

1, is the figure for the 2d, 9th, and 16th centuries.
2, " " " " " 1st, 8th, 15th, 18th, 22d, 26th, 30th centuries.
3, " " " " " 7th, 14th centuries.
4, " " " " " 6th, 13th, 17th, 21st, 25th, 29th centuries.
5, " " " " " 5th, 12th, 20th, 24th, 28 centuries.
6, " " " " " 4th, 11th centuries.
0, " " " " " 3d, 10th, 19th, 23th. 27th centuries.

EXAMPLE.—What day of the week was the 31st August, 1873? Sunday, Ans.

Process—

Last two figures of the year,	$73 - 70 = 3$
Quotient of Do. ÷ by four,	$18 + 3 - 21 = 0$
Day of month,	$31 - 28 = 3$
Figure for the month,	$5 + 3 - 7 = 1$
Figure for the century,	0

After casting out the sevens the remainder is 1: hence it was on the first day of the week, Sunday.

N. B.—The even centuries not divisable by 400 are not leap years.

1. Jay Gould had ninety rabbits; he also had three sons, named Jim Fisk, Emperor Norton, and Boss Tweed; to Jim Fisk he gave 10 rabbits, to Emperor Norton he gave 30 rabbits, and to Boss Tweed he gave the remainder; they each sold their rabbits at the same rates, and when all were sold they each had the same amount of money; state how this result was arrived at.

Jim Fisk sold 7 at the rate of 7 for $1 =	$1.00
" " 3 " " 1 for $3 =	9.00
	$10.00

Norton sold 28 at the rate of 7 for $1 =	4.00
" " 2 at the rate of 1 for $3 =	6.00
	$10.00

Boss Tweed sold 49 at the rate of 7 for $1 =	7.00
" " 1 " " 1 " 3 =	3.00
	$10.00

A Bin 9 ft. 6 in. long, 6 ft. wide, 4 ft. 3 in. deep, will hold how many Imperial bushels.

$\frac{19}{2} \times \frac{6}{1} \times \frac{17}{4} \times \frac{8}{10} - 4.845 = 188.955$ bushels. Ans.

NOTE. The imperial bushel is 2218.192 Inches, ten eighths of a foot, nearly, deduct 2½ from every 100 bushels in the product, this result multiplied by 8 will be the number of Imp. gallons,

What is the cost of 732 lbs. of Coal at $14. per ton, 2240 lbs. to the ton?

$$\frac{732 \times 14}{8 \times 4 \times 7} = \$4.575. \text{ Ans}$$

A bin 9 ft, 6 in. long, 6 ft. wide, and 4 ft. 3 in. deep is full of wheat, what is its value at $2.05 a bushel?

$\frac{19}{2}\times\frac{6}{1}\times\frac{17}{4}\times\frac{8}{10}+.87\times2.05=\$399.07.$ Ans.

Note. The standard bushel is 2150.42 inches; ten-eighths of a foot, nearly, the difference is .44 bu. in each 100. *R.*259,

Divide £1 into 3 parts in the proportion of A, $\frac{1}{2}$, B, $\frac{1}{3}$, C, $\frac{1}{4}$. $\frac{6+4+3=13.}{12}$ Ans. $\frac{6}{13}$, $\frac{4}{13}$, $\frac{3}{13}$.

How many cubic feet in a case 3 ft. 6 in. by 2 ft. 8 in. by 1 ft. 10 in?

$\frac{7}{2}\times\frac{8}{3}\times\frac{11}{6}=17\frac{1}{9}$ ft. Ans.

If 7 cats, kill 7 rats, in 7 minutes, how many cats will kill 100 rats in 50 minutes?

$\frac{7\times7\times100=14.}{7\times50}$ Ans. 14 cats.

If it cost $24 to carry 6 tons 20 miles, what will it cost to carry 12 tons 120 miles?

$\frac{24\times12\times120=288.}{6\times20}$ Ans. $288.

How many bricks will pave a walk 200 ft. long, by16 feet; bricks 8 in., by 4 in?

$\frac{200\times16\times144=14,400}{8\times4}$ Ans. 14400 bricks.

Multiply £19, 19s. 11$\frac{3}{4}$d by the number of pounds and fractions of a pound named.

£19,,19,,11$\frac{3}{4}$ $-$ £$\frac{1}{960}\times20+$£$(\frac{1}{960})^2=$

£399 $\frac{19}{20}$ $\frac{2}{240}$ $\frac{1}{921600}$

or £19,,19,,11$\frac{3}{4}$ $\times$ 20 $-$ $\frac{1}{960}$ $=$ £399,,19,,2 $\frac{1}{960}$ of a farthing.

$150 is due Jan. 1st., $78 is paid down, on July 1st., the account is settled by paying $78. What rate per cent is paid for the accomodation?

$$\$150-78=\$72.\ \frac{6\times2\times100}{72}=16\tfrac{2}{3}\text{ per cent.}$$

Find the value of an ounce of silver, gold being worth £3,,18,,7 per ounce, ratio $15\frac{1}{2}$ to 1. also 16 to 1.

£3,,18,,7 $\div\ 15\frac{1}{2}=60\frac{26}{31}$d. £3,,18,,7 $\div\ 16=58\frac{15}{16}$d.

Example: What is the interest on £100 for fourteen days at 3 per cent. per annum?

```
 100
  10
   5
────
.115
```

Ans. 2*s*. $3\frac{3}{4}$*d*.

2. What is the interest on 980 dollars for six days at 7 per cent. per annum?

```
  980
   98
   49
─────
1.127
```

Ans. $1.127.